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JULY 1955

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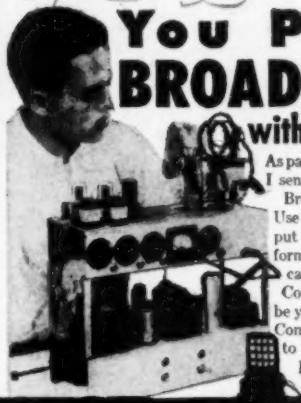

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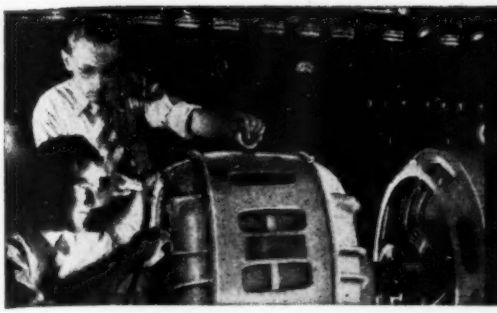

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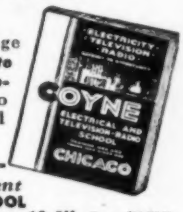

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If you are unable to find these listed products locally, write directly to the manufacturers at the addresses given. Also see the monthly review of new items of interest to the electronics hobbyist in "Tools & Gadgets" appearing on pages 109 to 112 of this issue of POPULAR ELECTRONICS.

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IN THIS MONTH'S

RADIO & TELEVISION NEWS

(July)

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Transistor Dip Oscillator

An "Improved" Sound Switch

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RF Signal Generator

Public Address System

Super-Het Radio Receiver

Combination Voltmeter-Ammeter-Ohmmeter

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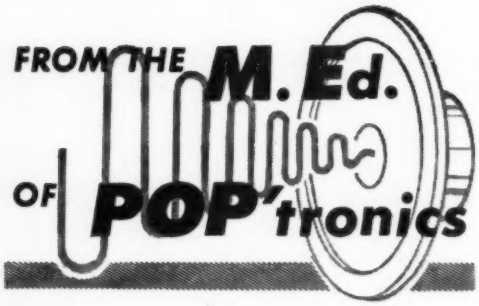

ALTHOUGH this July issue is classed as a "special feature" issue, our readers will be pleasantly surprised to find that five major electronic construction articles have been included, plus several articles on applications, and the usual numerous interesting features and departments. Your reaction to this issue—or format—would be appreciated, and I hope that I may have the pleasure of hearing from many of you in the very near future.

As an additional note to the "Bakersfield Story," I might mention that at this writing a woman prospector in the Kern River valley has just sold her claims for $500 cash and 10% of all mining profits. The uranium rush is still on, with claims recently staked in Vermont, Indiana, Illinois and New Jersey—not to forget similar unverified reports from Florida.

All mining authorities agree that uranium probably lies undiscovered in many localities. Some deposits will be found with the simplest of equipment, such as that described in this issue. The chances are in favor of the amateur prospector with only a limited amount of time and $40 to $50 to spend on a Geiger counter.

Might I suggest that potential authors read the short note on page 48 which outlines some of our present editorial requirements? Readers that have sent in inquiries of various kinds will also want to read this particular item.

Although every conceivable effort is made to produce a magazine completely devoid of errors, a few have managed to slip by. Fortunately, these have been of the most innocent and obvious kind; but for the sake of convenience—all future errors (when and if they occur) will be found under the title "Out of Tune."

o.p.f.

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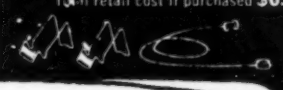

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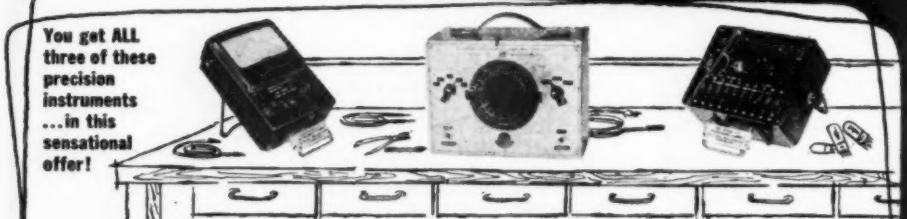

EMC model 106 VTVM
Price of this individual unit
Model 106 (wired and tested) $35.90
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Accessory probes available

EMC model 500 R.F. Signal Generator
Price of this individual unit
Model 500 (wired and tested) $29.75
Model 500 (in kit form) $19.75

EMC model 208 Tube Tester
Price of this individual unit
Model 208 (wired and tested) $24.90
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INVENTORS

If you believe that you have an invention, you should find out how to protect it. The first step is to have a search made of the prior pertinent U. S. patents. If a report on this search indicates that the invention appears patentable you can apply for a patent, and the specifications and claims should be prepared.

The firm of McMorrow, Berman & Davidson, with offices in Washington, D. C., is qualified to take the necessary steps for you. We can make a preliminary search on your invention, advise you whether we think it can be patented, and prepare your application for patent.

Unless you are fully familiar with the U. S. Patent Laws, we recommend that you engage the services of a Registered Patent Attorney to protect your interests. The patent laws are *your* laws. A patent gives you the right to prevent others from making, using or selling the invention claimed in your patent for a period of 17 years.

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Send for a copy of our Patent Booklet entitled "How To Protect Your Invention," containing information about patent protection and patent procedure. Along with this we will also send you an "Invention Record" form, for your use in writing down and sketching details of your invention. We will mail them promptly. No obligation. They are yours for the asking.

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LETTERS FROM OUR READERS

HI-FI TEST RECORDS

■ Can you suggest an LP record for use in testing the frequency response, turntable speed, etc., of a hi-fi system?

JOSEPH H. JORDAN
Milwaukee, Wis.

Most jobbers' catalogs list records available for these purposes. There is the series of test records made by Cook Laboratories. *One of these, in addition to testing your system for frequency response, also has provision for determining the condition of the LP stylus you are using.* Audiophile *and* Clarkstan *both make similar records. Of special note is a new* Vox *release. Incorporating a frequency test and stroboscopic markings for checking speed, this record is practically a course in basic audio.*

PORTABLE TRANSISTORIZED RECEIVER

■ I am interested in constructing a small transistorized broadcast-band receiver, which would be suitable for use as a battery-powered, portable receiver. A list of parts including a schematic and pictorial diagram would be greatly appreciated.

RICHARD JOHNSON
Verdun, Quebec

Fortunately, your request ties in with our future editorial plans. Watch for articles on this subject in our Fall issues.

CAREERS IN ELECTRONICS

■ I enjoyed the story on "Project Cyclone" in your April issue, especially the part dealing with opportunities for careers in electronics. The thing that bothered me, though, is this: you mentioned people with college degrees only. How about opportunities for technically minded people who don't have degrees? Or who are thinking of a course in electronics at some technical school? Could you publish a story on these aspects of the field?

J. R. LEDDING
Kansas City, Mo.

You took the words right out of our editorial files! We are scheduling, for the Fall, a survey on this very subject, including information on schools and opportunities for careers in electronics for the non-engineering-degree technically trained person.

D.C.-TO-A.C. CONVERTER

■ I would like to have instructions on how to convert 6 volts d.c. (automobile electricity) to 115-120 volts, 60 cycle, a.c. (house current). What I would like to do is put such a converter in my car to be used for an electric razor, radios and phonographs, and occasionally a tape recorder, on trips or picnics or such affairs where regular household current is not available.

If you could help me out, it would be greatly

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appreciated. I could go out and buy a unit to do this, but I feel it would be more fun to build my own.

JOHN LEE WRIGHT
Maple Heights, Ohio

We appreciate the feeling you have about the fun in building your own, but as things stand now, we have nothing planned in the way of a construction article for the type of converter (or inverter) you require. We can suggest any of several fine commercial units that will do the job. Among these are the ATR *inverters, the* Cornell-Dubilier *converters, and the* Terado *converters. Prices range from $10.00 to $50.00, depending on the unit's capacity and other features. We suggest a trip to your local parts jobber or a study of his catalog.*

TAPE CORRESPONDENCE CLUBS

■ Just thought I'd let you know that I tried contacting the "Record-O-Club," listed on page 30 of your May issue. It is not at the address given and apparently is no longer in existence.

R. G. LOVE
Spring Valley, N. Y.

Apparently this is true. We suggest you contact one of the other organizations listed for this area.

■ Add to your list of tape clubs (as in "Corresponding by Tape," May, 1955, issue): "Magnetofona Esperantista Kumunumo."

Those interested in wire or tape correspondence using the international language, Esperanto, should get in touch with:

Ole Nederland
Tommerup
Kalundberg
Denmark

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Bronx, N. Y.

REQUEST FOR BOOK INFO

■ Will you please send me the exact address of the "Pageant Press" publisher? I'd like to get a copy of their book "QRD? Snohomish" reviewed in your April issue.

A/1C C. H. BEHLER
APO 175, N. Y., N. Y.

The publisher's address is: Pageant Press, Inc., *130 West 42nd St., N. Y. 36, N. Y.*

HI-FI TAPE PLAYBACK

■ How can I feed the output of my tape recorder into a hi-fi system? I have been tape-recording musical programs from a broadcast-band radio, but find that playing them back through the amplifier and speaker included in my tape recorder is somewhat less than satisfying. I have a 15-watt amplifier and fairly good speaker. The amplifier has three receptacles on the rear cover. These are marked "preamp. in," "preamp. out," and "amp in."

K. C. DORRINGER
Philadelphia, Pa.

First, the amplifier described sounds like an old Bogen *Model PX15, although the* Scott *210A*

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had input receptacles similarly marked. To listen to any high-level program source (tuner, crystal or ceramic phono pickup, or tape recorder), simply connect the output of that unit to the "amp. input." To listen to a low-level source (magnetic pickup, or signal direct from a tape head), connect to the "preamp. input" and then connect the "preamp. output" and "amp. input" receptacles. In this case, it depends on what point on the tape recorder you are taking off your signal; if it's before the preamp in the tape recorder, you'll need the preamp in your hi-fi amplifier; if it's after the preamp in your recorder, you'll need to bypass the preamp in your amplifier. Incidentally, a switching arrangement to select either high- or low-level program sources is a simple affair, and need employ only a single-pole double-throw switch and some shielded wire.

COST OF BUILDING CIRCUITS

■ Members of our Radio Club all have mentioned the desire that you include in your articles an approximate total price for the construction of various units. This will help us decide whether we can afford to build such units.

FRANK H. BAMBERGER
Sun Valley, Calif.

We have been doing just this in most of our construction articles. We may have missed up on a few, but will make sure to include such information from now on.

FM RADIO PLANS

■ Can you send me plans for building a simple FM radio (with a speaker)?

GARY ROBIN
Chicago, Ill.

First, we cannot undertake to send plans for any circuits other than those that are available as published material in the magazine. Second, there are excellent kits available that can be used for building FM tuners, such as the Heathkit *FM-2. Third, there is no such thing as a "simple FM radio." Any FM receiver, by its very nature, is a relatively complex job and requires careful soldering, precision wiring, and critical lead lengths. A complete FM radio must include at least five stages: r.f. amplifier; frequency converter or mixer stage; i.f. amplifier; ratio detector (or limiter and discriminator, which means using another tube); audio amplifier and speaker. However, by constructing only a tuner, good results may be had by plugging the tuner's output into a separate audio amplifier. Until you get a separate unit, you can use the audio section of an AM radio in much the same way that you would use it to listen to a record player.*

SPARK-COIL SIGNAL GENERATOR

■ Where can I obtain information on a metal-pipe locator using a *Ford* Model "T" spark coil as as signal generator? I have seen two receivers used with this type of transmitter, but cannot make one which will pick up the signal.

V. A. BURTON
Encinitas, Calif.

Frankly, we have never heard of this type of rig. Anybody out there know about it?

—30—

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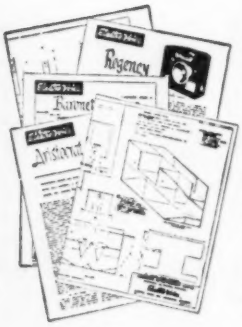
BULLETIN 194: Tells how you can enjoy at least one more octave of silky highs by adding T35 Super-Sonax Very-High-Frequency Driver to your extended range single speaker for a two-way system, to your coaxial for three-way, or to separate multiple two-way for super three-way.

BULLETIN 198: Ultra-Linear, wide range, constant amplitude ceramic phonograph cartridge described in full detail.

BULLETIN 197: Gives full information about the CDP compound diffraction projector for full-range public address reproduction.

CONSTRUCTION DRAWINGS



BULLETIN 172: Chart for building complete high-fidelity Residence Entertainment Center. Includes space for all audio components, radio-phonograph, television receiver, etc.

BULLETIN 173: Construction details and mounting information on how to build famous E-V Patrician folded-horn corner enclosure for today's outstanding four-way system.

BULLETIN 174: How to build Baronet corner enclosure for 8-in. speaker.

BULLETIN 175: Construction drawing on E-V Aristocrat corner enclosure for 12-in. speaker systems.

BULLETIN 176: Construction details on E-V Regency enclosure for two- and three-way systems.

CONDENSED CATALOG 123: 14 page digest of information on the many products produced by E-V; high-fidelity enclosures, speakers, speaker systems, microphones, phonograph pickup cartridges.

BULLETIN 185: Tells about E-V Regency folded horn enclosure with built-in corner for 15-in. coaxial speakers or separate two- and three-way speaker systems. Has full data on E-V Baronet corner enclosure for 8-in. speakers.

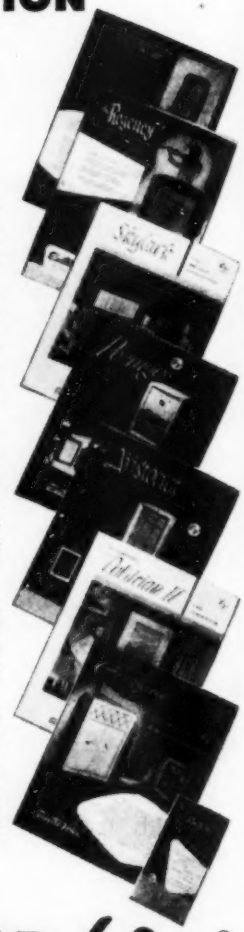
BULLETIN 219: Gives complete information about the space-saving Skylark 3-way loudspeaker system. Easily fits on a table or bookshelf in any room.

BULLETIN 189: Tells how to add octave of bass (and better highs) with E-V Aristocrat Klipsch-licensed folded-horn corner enclosure and 12-in. complementary speaker systems. Includes complete data on Peerage sound equipment console.

BULLETIN 220: Explains about the superb new E-V Patrician IV four-way audio reproducer in custom-crafted corner enclosure. Hi-fi experts say: "Finest of all."

BULLETIN 210: Tells about the new Georgian four-way reproducer in folded horn enclosure. Contains construction drawings.

BULLETIN 193: Illustrated 12-page folder on complete line of E-V high-fidelity enclosures.



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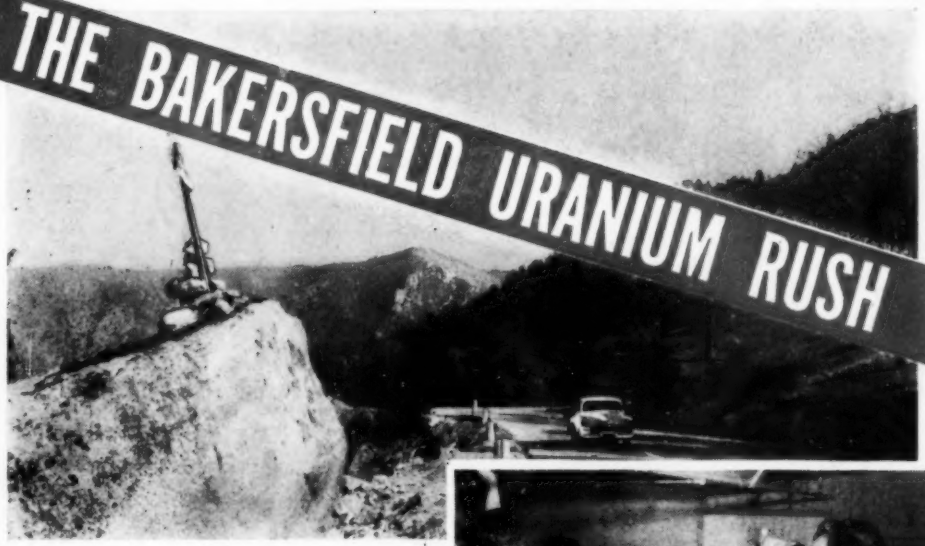
THE BAKERSFIELD URANIUM RUSH



(Above) A sign of our times. One of the crude markers for claims staked along Highway 178 in California.

(Right) Portion of the crowd on March 15 attempting to see the AEC anomaly map posted in Bakersfield, Calif.

By LEO G. SANDS

Our grandfathers talked of gold and silver, our fathers sought oil, but today's biggest and most rewarding goal is—URANIUM!!!

THE YOUNG Atomic Energy Commission geologist rocked back in his chair while a soft smile crept over his sun-tanned face. He paused for a moment, and said:

"You know, Kern County (California) is about the 'hottest' and most publicized uranium area in the country today—and without a doubt, the least productive."

But that's only true of the present. What the future holds is anyone's guess. It may well become one of the nation's greatest producing areas of uranium ores—or it may be a total bust.

As one veteran mining engineer pointed out, "Don't forget, the AEC doesn't open a special office in an area for nothing. And this is still their only field office in California. If they didn't really think something would come from the explorations here, they probably would have packed up and gone home long ago."

"The Great Uranium Rush" which burst over Bakersfield, Calif., late last year isn't the first time the natives have gone through such a boom. But it certainly takes the cake as the most publicized boom in the city's history.

As pipe-smoking Jim Day, long-time managing editor of the conservative "Bakersfield Californian," pointed out: "Frankly, the thing got a little out of hand—and I personally think it became grossly exaggerated. Some of these 'prospectors' were staking claims on private property, state land, utility easements and everything but my front porch. Naturally we all hope that commercially profitable strikes are made. New business is good for any community."

He continued, "We have 'played' the story down for obvious reasons. Most of it is speculation so far, and until more comes of it, we'll keep right on. It's a good story, but even I can remember better ones."

AEC Field Work

The AEC field team appreciates the work of the amateurs. They know that many of the big strikes of commercial ore were

DETROIT PUBLIC LIBRARY

(Left) Amateur prospectors "zero-in" on a sample from the now famous "Miracle Springs Mine."

(Below) Over 500 copies of the first AEC map were sold by Earl Price & Co. as blueprints.

discovered by the rankest of amateur prospectors. And their only job now is to explore fully as much of the country as they can, in shortest time and at lowest cost.

They continually urge prospectors to consult with them freely, not to spend a lot of money in their search, and not to count on getting rich. The AEC knows much of it is back-breaking hard work, and 99% of it likely to produce nothing more than a sunburn, tired feet and a mirage of riches.

But for the security of the country, every possible uranium source must be searched, and if enterprising citizens want to enter the one-in-a-million stakes for commercially profitable ore—the AEC is out to help all it can.

William Bowes is the AEC geologist in charge of the Bakersfield field office, and he's been there since May, 1954. Later he was joined by John Tillman and Wayne Moen.

Bowes was publicized on a nation-wide scale as soon as the AEC field office published its first anomaly map. Newsreel and television camera crews set up shop on the street in front of the building, and he told the American people in simple terms what they had found.

The television and newsreel shots, plus the newspaper publicity, boosted the mail to the tiny office to huge proportions, and all three of the AEC representatives were bombarded with telephone calls 24 hours a day.

Kern County has a little more than a quarter of a million residents, of which about 150,000 live in or near Bakersfield, the county seat. Many natives will tell you that probably no more than a few hundred have actually taken to the hills in search of the magic ore. But the AEC and others know that literally thousands of people have "gone prospecting" in the past few months. Where did they come from? Frankly, from all over, but the majority came from the Los Angeles area.

What the AEC didn't count on when it published the first uranium anomaly map at 11 a.m., March 15, 1955, was that most of Southern California would rise up and rush for the hills. Many newspapers sent reporters and photographers into the area; some even published portions of the map. It was the first time that the AEC had published a map—counterparts of which are being published in scores of other areas with little or no public attention—close to a large metropolitan area. This probably accounts for the king-sized "rush." Much of it was highly magnified by competing newspapers and press associations.

Filing of Claims

One of the most over-worked groups in Kern County is County Recorder Charles H. Shomate and his staff of 16 deputies. And none of them have climbed the mountains in search of ore yet—they're still busy poring over the mountains of mining claims filed by the prospectors.

Recorder Shomate has served Kern

Left to right are Brooks Mann and Chris Musick, two of the discoverers of the Miracle Mine, and Stewart Patterson, mine manager. Mann and Musick are natives of Taft, Calif.

Joe Mosbrucker, on the left, and Tom Gribbin set up a jack-leg drill in the Miracle Mine. At this writing, it was the only California mine to have shipped out a carload of commercial uranium ore.

County for 32 years and admits he's a little baffled by all the fuss. Kern County has no court house as such, and most of the buildings housing separate divisions of the county government were destroyed in the big earthquake of 1953. The recorder's office "galloped around six or eight feet in every direction," Shomate said, "but finally came to rest on its own foundation with only minor damage."

The mere filing of claims is only part of his troubles stemming from the uranium rush. Few people have any idea how to file a claim—and there's been little change in the procedure since the Gold Rush days a century ago. The property must be on Federal land, it can measure no more than 600 feet wide and 1500 feet along the vein or lode, and it must be "worked" in 90 days.

Shomate has had to publish extracts of the law regarding claims and then still must help the would-be "rich miner" prepare the paper work. The biggest trouble is locating the property, he says. Many people drop in and say, "File me a claim about 12 miles out of town in the Kern River Canyon—you can't miss it—I put up a stack of rocks and painted it red with my name on it." Actually, every claim must state the exact location by section number and subsection according to the official land map of the area. Consequently, many claims are misfiled. But the recorder does not have to justify the claim; he merely records where the prospector claims it to be.

Because of the stories about the uranium rush, Shomate has been deluged with mail. Much of it is sincere, but other letters are threatening and many are humorous.

One lady wrote from North Carolina asking Shomate "to select a nice claim and file it in my name, as it would be inconvenient for me to come to Kern now." Then she compounded this work by asking him to locate an "honest miner" and give him 41% of the claim for working it for her. She thoughtfully offered to pay all "incidental expenses incurred by you."

A veteran prospector in Bakersfield is Gene Buerkle, operator of the *Tejon Body Works* in town. He relates how 10 airmen from nearby Edwards Air Force Base—prospecting for tungsten—found what they believed to be uranium in Red Bank Canyon and staked 35 claims. They reportedly traced one vein over 4500 feet and have

been told that the ore has an estimated value of over $1,000,000.

"Miracle Mine"

But what is the status of the uranium search?

There are two mines actually working in Kern County, and only one has shipped any ore. That one is located in the Kern River Canyon about 35 miles northeast of Bakersfield and is called the "Miracle Springs Mine." It is owned by M. W. Ditto, one of the country's leading mining engineers.

Ditto bought the mine from seven Bakersfield and Taft amateur prospectors for $1,000,000. Since the claim had not proved commercially profitable, Ditto paid $35,000 in cash and will pay 12½% of the profit (if any) until the million dollars is reached. Plans have been drawn to spend $250,000 attempting to prove out the mine—and it may yet be a "dud." From current samples, he expects to recover perhaps half of this amount during the exploration period.

The Miracle Springs Mine property includes about 400 acres of land, part of which is in a Federal Power Withdrawal area. This means that the mine cannot be officially worked until the Federal Power Commission releases the property as unnecessary to the needs of future power requirements.

At one time, M. Stewart Patterson, who operates the mine, had 11 men working in the single 300-foot tunnel; but pending Federal permission, only five are now working. Later, 50 or 55 men will be employed, he said.

When the mine goes commercial, the operators will send the ore to Bakersfield and the AEC will ship it to the nearest rendering plant. The AEC also pays six cents a mile to ship it to town—so actually the AEC price will be f.o.b. the mine.

AEC geologists have inspected the area several times and have high hopes for the mine. They say the original shipment tested as high as 30% uranium concentrate. But other samples have tested as low as half of one per cent, the lowest rate considered to be commercially acceptable.

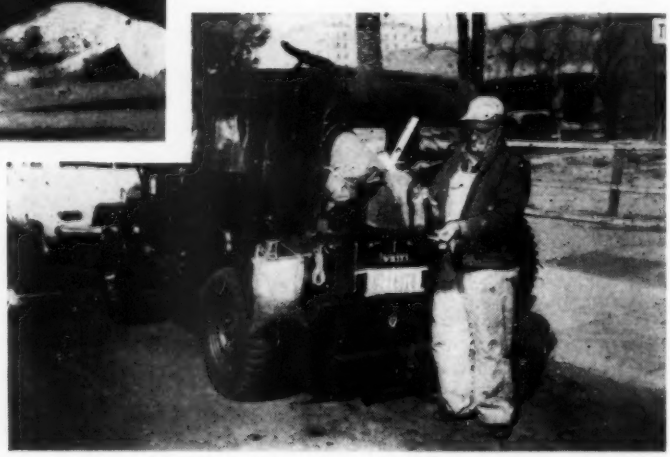
Patterson agreed that while the amateurs were a great help it was really the AEC that was doing the top-notch job in "proving the area." Scores of flights have been made by AEC pilots and observers, and it is from these aerial readings that the anomaly maps are published on the 15th of each month. These are areas where higher than normal readings are recorded by the airborne scintillation counters or scintillometers.

Prospecting is being conducted in most of the surrounding California counties such as San Luis Obispo, Santa Barbara, Inyo and Los Angeles. The best finds are still reported in Kern County.

Several stores in Bakersfield sell electronic prospecting equipment, but an alert merchandising manager at the Bakersfield *Sears Roebuck* store has perhaps done the best job. Now he sells them "over the counter" and has a film for teaching new prospectors the tricks of the trade.

That's the story of the Great California Uranium Rush in the spring of '55. Commercial possibilities have yet to be proved. Like the oil boom around the turn of the century—there are tremendous potentials. —30—

The Kergon Mine is a few miles west of the Miracle Mine in the Kern River canyon, near Bakersfield, Calif.



Charles Volenec checks his prospecting field equipment while waiting for the AEC map to be unveiled, March 15.

Special Feature

MARKET SURVEY OF GEIGER COUNTERS

Prepared by the staff of POPULAR ELECTRONICS

"Ore Claimer" Model GC-114—$15.95 *(Philmore).* This small kit will enable the constructor to build a Geiger counter weighing about 2 pounds. It requires a single 1½-volt battery and one 22½-volt "B" battery. The G-M tube is a CK-1026 excited by a single 1U5 in a special voltage multiplier circuit. This kit is available completely wired for $19.95. A similar instrument is distributed by the *American Laboratories,* but is not available as a kit.

"The Spotter"—$17.50 *(Stowers & Son).* A kit. See listing under same name at $25.00, completely wired and tested.

"Kit No. 1"—$19.60 *(Swift Optical Co.).* This basic kit includes the components to build a simple Geiger counter. The price does not cover batteries, but does include the G-M tube, capacitor, resistor, jack, switch, and wiring diagram. This company also supplies two other Geiger kits and a special power supply kit. Kit must be breadboard-mounted or used in a chassis supplied by the constructor. Further information may be obtained directly from the supplier.

"Model 803"—$19.95 *(EICO).* Recently released, the "Model 803" kit is also available as a fully wired instrument for $29.95. It is lightweight (about 3 pounds) and measures 7" x 4½" x 2¼". A 900-volt G-M tube insures good sensitivity. Flashing neon lamp and earphone may be used for indication of deposits. Batteries (not supplied with the kit or wired instrument) include two 67½-volt "B" batteries and two 1½-volt flashlight-type cells. Battery life is expected to be about 200 hours in normal use. The circuit uses two 1U5 tubes in a special multiplier arrangement. Kit and wired unit are sold with ore sample for calibration and full instructions.

"AD-ON" Model G-1—$19.95 *(Precise).* Representing a new approach to flexibility, the basic kit (not including batteries) contains a transistorized audio amplifier and a unique alarm system. The latter produces a loud tone signal instead of a "click" when a deposit is discovered in a low intensity area. Features of the "AD-ON" include a meter adapter, a ganged G-M tube assembly, and a scintillation counter adapter. Requiring a single 67½-volt battery, the kit is sold with earphone, carrying handle, and instructions. Wired and assembled units are also being made available.

"Geiger Flasher" Model RFN—$24.95 *(Nucleonic Company of America).* This novel instrument consists of a small Geiger tube mounted in an aluminum anodized finished housing. At one end is a "peep-hole" for a neon flasher that the manufacturer claims may be seen in broad daylight. The housing is 13½" long and 1⅝" in diameter. Batteries to actuate the flasher are carried in a separate case and consist of two 67½-volt batteries and one 1½-volt flashlight cell. Claimed sensitivity is 0.05 mr/hr. Earphone (if used) and batteries are extra charges. Essentially, the identical instrument is also available from the *U.S. Geiger Co.* at this price.

"The Spotter"—$25.00 *(Stowers & Son).* "The Spotter" is also available as an unwired kit for $17.50. It features a CK-1026 tube built into a metal case measuring 6½" x 3½" x 2". The unit weighs 1½ pounds with batteries. Battery life is claimed to be about 100 hours based on 4-hour per day use. Required are one 22½-

A complete summary of commercially available Geiger counter instruments and kits. Detailed information is included on price, sensitivity, weight, battery life and replacement costs, probes, and accessories.

EICO Model 803—$19.95 kit.

Precise "AD-ON"—$19.95 kit.

volt "B" battery and one flashlight cell. Replacement cost is about $1.50. The instrument is supplied with batteries, headset, instructions, Geigerscope, and ore sample.

"Uranium Detector" Model M-9 — $29.50 *(Magna)*. This kit employs a 1B85 G-M tube in a simple circuit that features the spark gap method of voltage buildup. A 3S4 tube is also used. Batteries required include a 45-volt "B" battery and a single 1½-volt flashlight cell; their life is claimed by the manufacturer to be about 100 hours under normal use. Model M-9 is sold complete with wiring diagrams and single headphone unit. Batteries are extra, about $2.00. This unit is also marketed by the *Concord Radio Co.* as a kit and as a completely wired unit for $39.50.

"Hot Rock" Model GMC-103—$29.95 *(American Laboratories)*. At this writing, the "Hot Rock" is one of the few low-cost instruments featuring a built-in loudspeaker. It can be used with headphones, and tip jacks are provided. Circuit is designed for a 900-volt tube (self-contained) which is powered by the capacitor-charging method. It is sold complete with batteries, single earphone and instructions, and is also available in kit form for $24.50. This instrument is also marketed under the *Philmore* brand name as their Model GC-113.

"Snooper" Model 108—$29.95 *(Precision Radiation Instruments)*. This little unit measures about 1½" x 3" x 5" and weighs just a little over 1¼ pounds. The 300-volt Geiger tube operates from one flashlight cell and a single 22½-volt hearing-aid type battery; according to the manufacturer, they should last between six and twelve months. The "Snooper" actuates a pair of headphones which enables the operator to determine the proximity of radioactivity by the number of *clicks* per unit time. In general terms, the "Snooper" is about one-third as sensitive as the "Lucky Strike" (Model 106) and "Professional" (Model 107) which are manufactured by the same company.

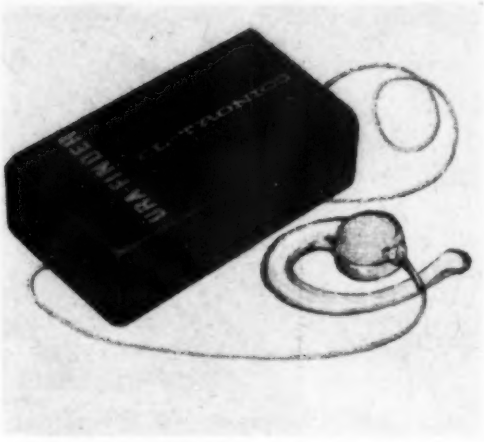
"M-Scope" Model C-18—$35.00 *(Fisher Research Laboratory)*. Weighing only 1½ pounds, this small unit measures 1½" x 4" x 5". It is compact and rugged enough to be carried around in a jacket pocket. The "M-Scope" employs the "click" method of audible detection and is shipped complete by the manufacturer with earphone, batteries, instructions and ore sample.

"Claimstaker" Model DG-5—$37.50 *(The Detectron Corp.)*. Reported by the manufacturer to be the "quality" Geiger counter of the very low price field, the "Claimstaker" is built into a plastic Royalite case with "on-off" switch and "charging" button placed conveniently on the top edge. The unit is pocket-size and weighs about 1½ pounds. It uses the "click" method of detection and is sold complete with single earphone, ore sample and instructions.

"Ura Finder"—$39.95 *(El-Tronics)*. Another quality product of the low price field is the "Ura Finder." It features extremely small size (1⅛" x 2$\frac{5}{16}$" x 4") and weight (about 1½ pounds). In place of the usual headphone and band, the "Ura Finder" is sold with a hearing-aid type earpiece. The plastic case of the counter fits into a cowhide case that may be clipped to the operator's belt—thus providing a maximum of convenience. This unusual instrument is powered by a single tiny penlite battery. Instructions, ore sample, battery, and earpiece are forwarded to each purchaser.

"Sierra" Model 88—$49.50 *(Sierra Scientific)*. A small kit, the Model 88 features a

Stowers & Son "Spotter"—$17.50 kit.



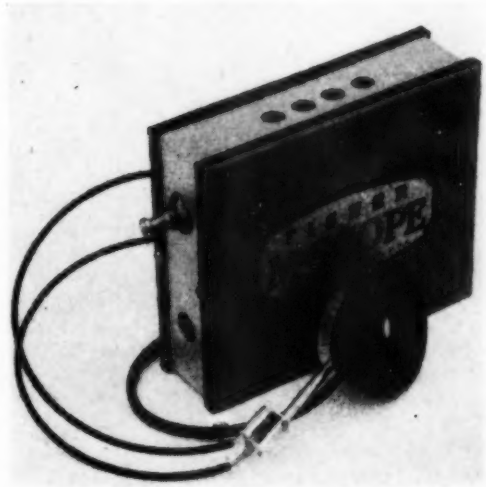
El-Tronics "Ura Finder"—$39.95 complete.

printed circuit to alleviate many of the wiring problems for the home constructor. Three sensitivity ranges are also provided using a 200-microampere meter. Earphones, neon flashing and metering serve as the means of uranium identification. Measuring 4½" x 8" x 3½" and weighing about 6 pounds, this unit is sold complete with instructions on assembly, ore sample, and operating notes.

"El-Mec Do-It-Yourself-Kit"—$49.50 *(El-Mec Products, Inc.)*. This unwired kit is similar to the EM-50 Geiger counter sold by the same concern at $84.50 (reviewed below). It includes a neon flasher lamp circuit.

"Eldorado" Model PR-4—$49.95 *(El-Tronics)*. The "Eldorado" is a counter of intermediate design and price, featuring small size (about 1¾" x 4" x 7") and rather low weight (about 4 pounds). It drives headphones and also operates a neon flasher mounted on the top edge of the case. Battery supply consists solely of ordinary flashlight cells. The manufacturer claims that a beta "window" is provided in the case (hammertone finish) for extra sensitivity. Model PR-4 is sold complete with black plastic shoulder strap, batteries, earphone, instructions, etc.

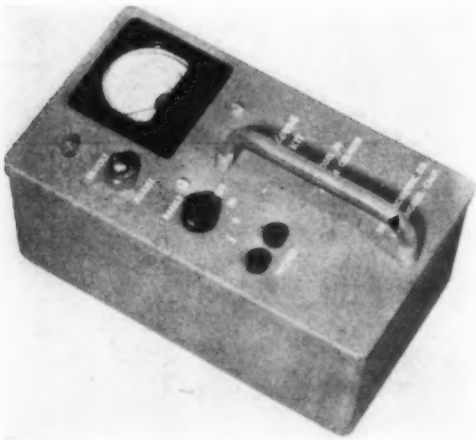
"Model K-1 Kit"—$49.95 *(J. Young & Company)*. This is one of the very few transistorized Geiger counters available to the prospector. The saving in weight results in a small package measuring 3¾" x 6¼" x 2" and weighing only 2 pounds. Two transistors are used, one as meter amplifier and one as a high-voltage "inductive-kick" oscillator. This unit also is metered with a fixed full-scale reading of 2.0 mr/hr. A mercury cell battery lasting about 200 hours and a 22½-volt hearing-aid battery are required. Kit is complete with wiring instructions and necessary components.



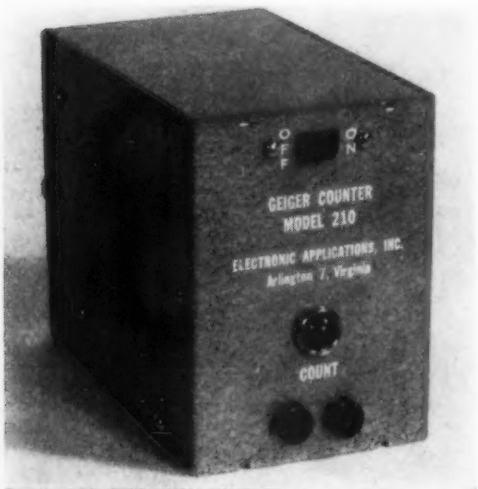
Fisher "M-Scope"—$35.00 complete.

U. S. Geiger Co.—$24.95, less batteries and earphones.

El-Tronics "Eldorado"—$49.95 complete



Sierra "Model 88"—$49.50 kit.



Electronic Applications—$52.50 kit.

"Model 210"—$52.50 *(Electronic Applications)*. This is a compact unit measuring 3" x 4" x 5" and weighing about 2 pounds. It features a CK 1026 G-M tube of the 900-volt sensitivity series. The "Improved Model 210," which has just been released, has an adjustment to permit precise setting of the G-M tube operating voltage. A pair of earphones is driven through an audio amplifier system. Neon flashing is used in this circuit for visual counting or identification. Batteries required include a 45-volt "B", a penlite cell, and a mercury cell; battery drain is claimed by the manufacturer to be very low. This identical unit is available in kit form for $38.50.

"Uranium Finder" Model RDN—$59.50 *(Nucleonic Company of America)*. A compact unit weighing less than 3¾ pounds and measuring 7" x 4½" x 3¼", Model RDN is mounted in a watertight blue hammertone case. It has provisions for neon flashing as well as earphones. Battery life is expected to be 200 hours in normal use. The "Uranium Finder" is sold with carrying handle permanently attached to the case, and a separate carrying strap.

"Simplified Counter" — $65.00 *(Barrett)*. This unit is also available as a kit for $49.00. It uses the 900-volt 1B85 G-M tube and a 300-volt battery. The "Simplified Counter" is claimed to have a sensitivity approaching counters in the $150 class. Further information may be obtained from the manufacturer.

"El-Mec" Model EM-50—$84.50 *(El-Mec Products, Inc.)*. Weighing under 3 pounds and measuring 4" x 4" x 6¼", the "El-Mec" Model EM-50 incorporates a 50-microampere meter to register 0.2, 2.0 and 20.0 mr/hr. The neon flasher can also be used to indicate when the batteries are low. Power supply consists of two 1½-volt batteries and three 30-volt batteries, with replacement cost estimated at $3.50. Battery life is claimed by the manufacturer to be over 100 hours. The Geiger tube is built into the case; the manufacturer will supply the same instrument with a bismuth tube (which will double sensitivity) at an extra charge. Unit is sold complete with earphones.

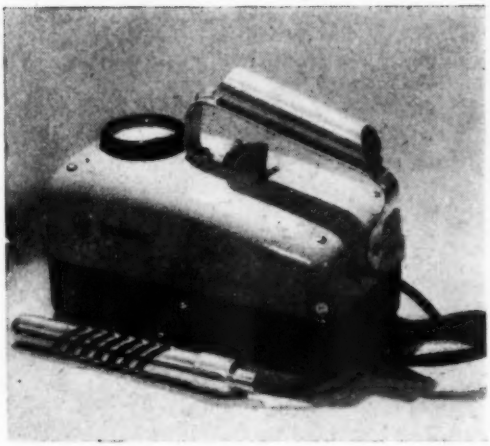
"Practical Prospector" Model GMC-101—$89.50 *(American Laboratories)*. An external probe instrument with a loudspeaker built in is the principal indicating device. The probe is chrome-plated and is claimed by the manufacturer to be so designed that directional openings discriminate between beta and gamma rays. The 900-volt Geiger tube (1B85) is voltage-sup-

ply-regulated. Battery operation drain is claimed to be very low. The supply consists of only one 67½-volt miniature battery and two flashlight cells. The case is aluminum with a blue hammertone finish. There is no meter or neon flasher. Count is determined by ear with either the speaker or single earphone. The Model GMC-101 is sold complete with batteries, carrying strap, instructions, etc. This circuit is also used by *Philmore* and sold under their title of "Detect-Ore." *Philmore* also distributes this unit with bismuth tubes at $119.50.

"The U-238-C"—$94.50 *(Goldak Co.)*. The main feature of this instrument, according to the manufacturer, is the use of a highly sensitive metering circuit. Metering ranges are: 0.1, 1.0 and 10.0 mr/hr. Basically, the circuit uses a 1B85 G-M tube built into a case measuring 3" x 4" x 7" and weighing about 3¾ pounds. The unit also features printed circuitry and voltage regulation of the G-M power supply. Batteries required include two 45-volt "B" batteries and two flashlight cells. The manufacturer claims a battery cost replacement of $4.15 and an average life of about 150 hours under normal usage. This unit is sold complete with single earphone, carrying strap, ore sample and instructions.

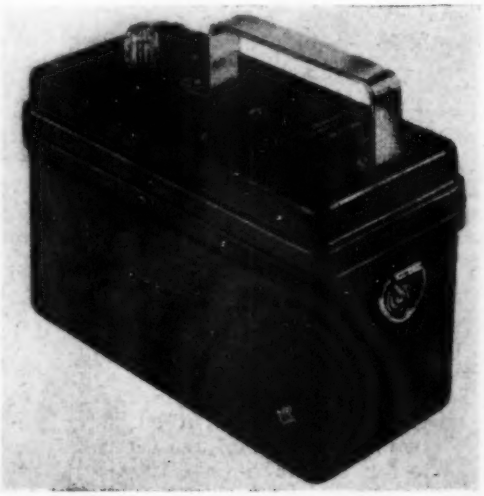
"Detectron DG-2"—$98.50 *(The Detectron Corp.)*. This is a self-contained unit weighing about 5 pounds. The metering circuitry provides linear readings from 0.0 to 0.2, 2.0, and 20.0 mr/hr. Waterproofing and tropicalized construction are also featured. Headphones, meter or a neon flasher may be used as the indicating mechanism. The G-M tube is of the 900-volt series and battery drain is claimed by the manufacturer to be very low. The "Detectron DG-2" is sold complete with instructions, six ore samples, carrying belt and headphones.

"Uranium Scout"—$99.50 *(Fisher Research Laboratory)*. A self-contained unit using two CK-1026 Geiger-Mueller tubes, this model measures 4¼" x 4¼" x 7⅝" and weighs approximately 4¾ pounds. Batteries required include two flashlight cells, one 45-volt and one 67½-volt hearing-aid type. The manufacturer claims that with four-hour-per-day use the flashlight cells will last for 125 hours of operation and the "B" batteries about 600 hours. The "Scout" is metered with ranges from 0.0 to 0.12, 1.2 and 12.0 mr/hr. Featured is a calibration control on the panel to enable field checks on sensitivity; this control may also be used to increase sensitivity by disregarding the meter calibration. Normally, meter ranges are held so that they are linear. There is a jack for headphones, but no neon flasher. The unit is sold complete

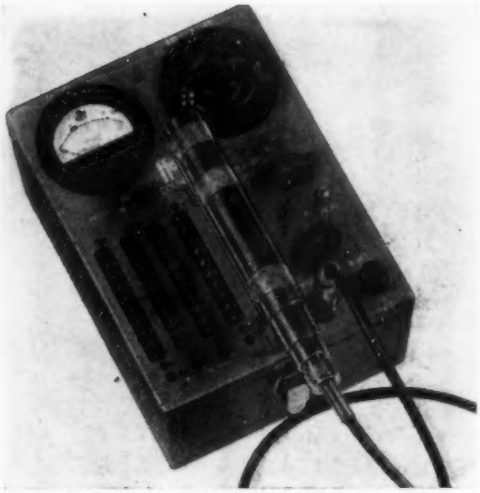


El-Mec "Model E-M100"—$109.50, complete.

Detectron "DG-2"—$98.50.



Nucleonic Co. "Uranium Finder"—$59.50.



Hoffman Radio "Countmaster"—$250.00.

Philmore "Detect-Ore"—$89.50.

with carrying strap, batteries, full instructions, etc.

"Lucky Strike" Model 106—$99.50 *(Precision Radiation Instruments)*. This is a fully enclosed unit which the manufacturer designed especially for rugged use. A 900-volt Geiger tube is built into a case measuring 3½" x 4½" x 6½" and weighing just over 5 pounds. The "Lucky Strike" includes a metering arrangement with three scales from 0.0 to 0.2, 2.0 and 20.0 mr/hr. It also includes an automatic voltage regulating circuit and is tropicalized. A neon flashing bulb is on the panel, and there are tip jacks for a pair of headphones. Battery replacement cost is about $5.35 (manufacturer's figure) and requires the same units as the *P.R.I.* Model 107. Model 106 is sold complete with batteries, calibrating ore sample, earphone, carrying belt and instructions.

"Gun Type Counter" Model 411—$99.50 (*Universal Atomics*). An unusually styled counter, Model 411 features a completely transistorized circuit driven by four flashlight cells. The ratemeter is designed to read 0.02, 0.2, and 2.0 mr/hr.; the scale also reads in counts-per-minute. Case is drawn aluminum with a baked hammertone finish, and weight is less than 4 pounds. The unit is sold complete with beta shield, G-M tube, batteries, instructions, etc.

"Walking Stick" Model 402—$99.50 (*Universal Atomics*). This Geiger counter is actually shaped and handled like the common walking stick. It is 40" long and about 2" in diameter. In the handle is the battery supply (two flashlight cells) and the transistor circuit for the 1B85 G-M tube. A light cable connects the "Walking Stick" to a transistor audio amplifier that the user can carry in a shirt pocket or fastened to his coat. This amplifier operates a pair of earphones. The "Walking Stick" weighs 3 pounds and is sold with a special shield for beta discrimination.

"Three-Range Counter" Model PR-5A—$99.95 (*El-Tronics*). The latest version of the Model PR-5 series incorporates a built-in G-M tube which is of the halogen type and capable of infinite service. Powered by only two flashlight cells, the unit measures 3¾" x 3¾" x 7⅞" and weighs about 7 pounds. Metering is provided with ranges from 0.0 to 0.2, 2.0 and 20.0 mr/hr. A very special feature is the design of the carrying handle which is curved to fit the hand comfortably and to protect the meter if the instrument is dropped on its face. Neon flasher or headphones may be used. This model is sold complete with plastic strap for carrying.

"El-Mec" Model E-M100—$109.50 *(El-Mec Products, Inc.)*. A polystyrene case is used to mount and protect this prospecting instrument. The probe may be slipped into a special tubular slot in the handle for easy carrying. The complete unit weighs 6 pounds. Battery life is claimed by the manufacturer to be about three months of normal use. Replacement cost of batteries is about $3.00; included are one 67½-volt battery, one 3-volt battery and one 1½-volt flashlight cell. The instrument may be used with or without earphones. Case dimensions are: 4½" x 5" x 8½"; and a beta shield is sold as an extra item for $5.00.

"Vic-Tic" Model 631—$125.00 *(Victoreen Instrument Co.)*. This four-range sensitivity Geiger counter features a transistor audio amplifier circuit driving a loudspeaker.

El-Tronics "Military"—$159.95 complete.

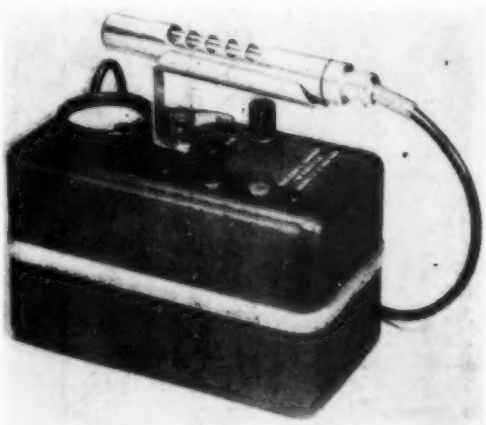
Universal Atomics "Gun-Type"—$99.50.

Earphones are not required. Fully metered with scales of 200, 1000, 10,000 and 100,000 counts per minute, the "Vic-Tic" weighs only 3 pounds. Battery requirements are one 1½-volt cell and one 67½-volt "B" battery. The manufacturer claims a battery life of over 100 hours with a normal use of four hours per day. Model 631 is sold complete with either a canvas carrying case or shoulder strap. *Victoreen* also makes available a number of important accessories for use with this instrument. A detachable hand probe with cable and tube is sold for $19.50. A bismuth pack of six bismuth tubes to increase the sensitivity at least 12 times is sold for $115.00; it is easily attached to the "Vic-Tic" and adds only 1 pound in weight. Deep hole probes, cables, and special carrying cases are also available.

Victoreen "Vic-Tic"—$125.00 complete.

"Uranium Scout de luxe"—$139.50 *(Fisher Research Laboratory)*. Here is an unusual instrument featuring a detachable prospecting stick to explore inaccessible areas. The manufacturer claims that this enables prospecting from horseback and is a protection in snake-infested areas. Circuit, metering and battery life are similar to the *Fisher* "Uranium Scout" except that a 1B85 tube is used in the probe. Weight, including the prospecting stick, is about 5¼ pounds. The "Scout de luxe" may be used with a drill hole probe and cable also sold by the same company in 100-, 250- and 500-foot lengths. Regular probe is available with a bismuth G-M tube for $17.50 extra. *Fisher* also distributes this model with a gun-type probe holding two CK-1026 tubes, visual ratemeter and meter zero trigger switch for $189.50.

(*Continued on page* 97)



Nucleonic Co. "Ore-Lokator"—$149.50.

Home-Built

700 VOLT GEIGER

Going prospecting? Here are two versions of a simple unit well suited for this venture.

REMEMBER the lurid tales of the gold rush of 1849? These tales are being re-enacted and enlarged upon many times over in the modern "gold rush"—the search for uranium. Prospectors of all ages are arming themselves with Geiger counters, scintillation counters, or just a grubstake, and are invading all areas of the world where there is the slightest prospect of discovering uranium ore.

This "rush" has stimulated a tremendous interest in devices for detecting radioactive ores. An idea of the interest aroused can be obtained by scanning this issue—the Bakersfield story is perhaps the best example, while the survey article on radiation-detecting instruments indicates the wide variety of equipment being sold for prospecting purposes.

Most widely used of all instruments is the Geiger counter. It is essentially an electronic device and, as such, is of interest to electronic experimenters. It is also essentially simple to build—increasing the range of interest to cover those who want a Geiger counter but do not have an extensive knowledge of electronics.

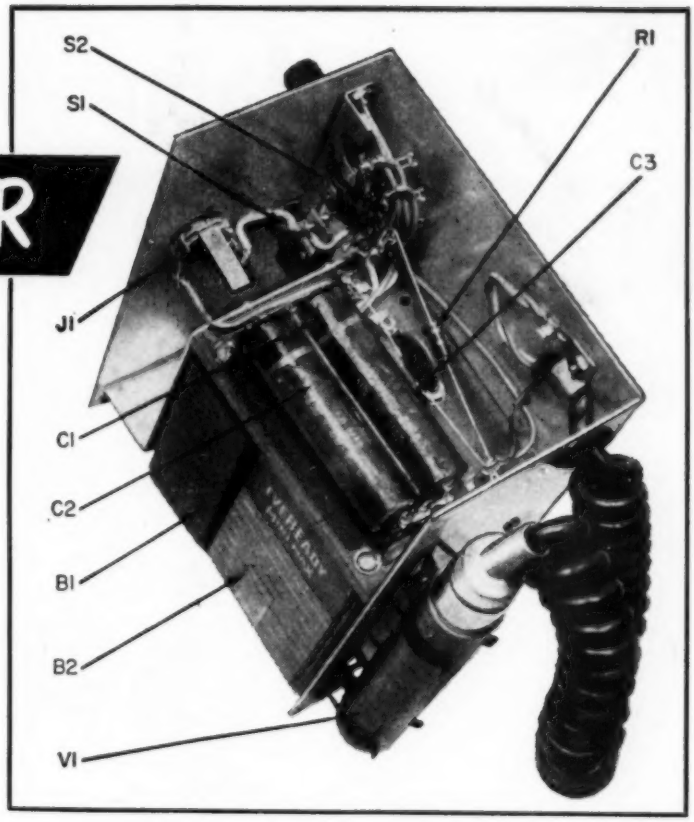
Although commercial instruments are available at a reasonable cost, it is much more satisfying and usually cheaper to "build your own." This article describes two units which are inexpensive and easy to build. The first provides clicks in a pair of headphones to indicate radioactivity, while the second includes a meter indication and a neon flasher as well as an amplified headphone signal. Both instruments are highly effective in locating radioactive material.

Before describing these units, it might be well to review the operation of a Geiger tube and to discuss radioactivity briefly in order to provide a background for a better

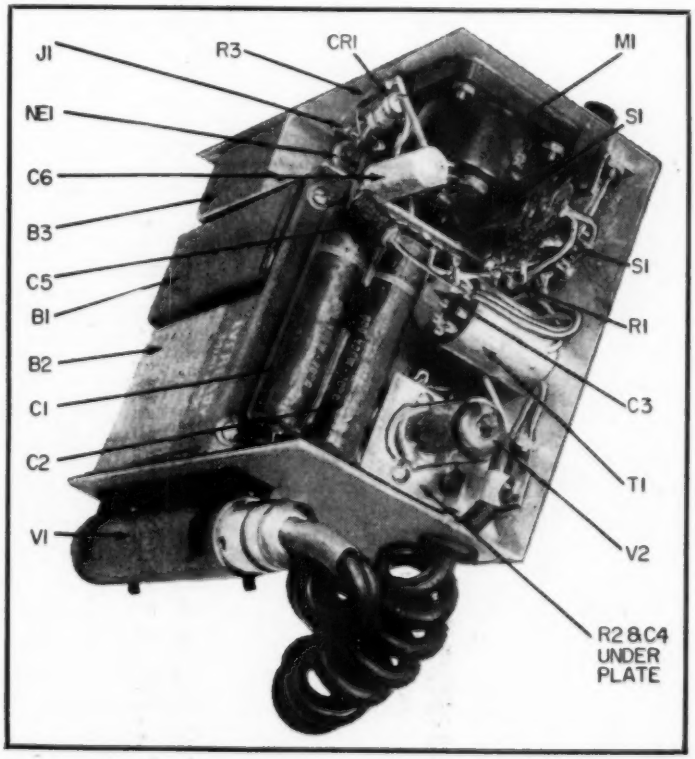
COUNTER

Cover Photo Story—

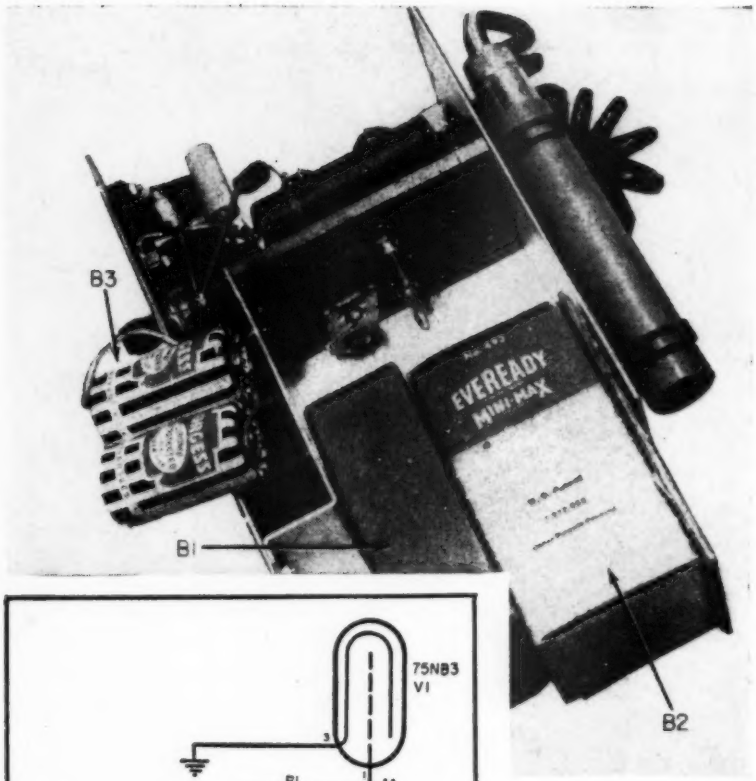
Painting by
Ed Valigursky



Interior view of simplified counter with the various parts identified. Construction is easy, and operation is satisfactory for casual prospecting where low headphone volume is not a drawback. See Fig. 1 for circuit diagram.



Interior view of the de luxe unit. Refer to the schematic of Fig. 2. Increased headphone volume, a neon flasher, and a meter are features of this unit. Construction is somewhat more difficult than that of the simplified counter shown above and in Fig. 1.



Interior view of battery compartments. A battery plug is used for B1, banana plugs for B2, and the two flashlight batteries (B3) are wired directly into the circuit.

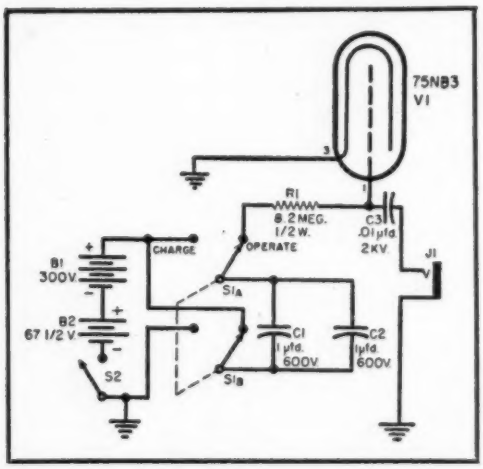
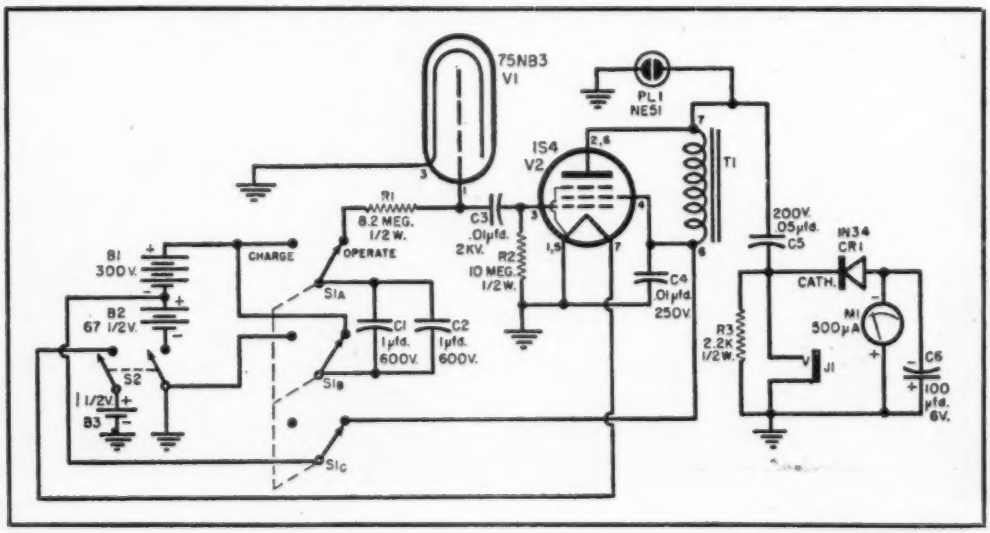


Fig. 1. Schematic diagram of simplified Geiger counter for headphone operation only. Parts list is on the facing page.

Fig. 2. Schematic of de luxe counter, incorporating a neon flasher and a meter. See facing page for complete parts list.



PARTS LIST FOR SIMPLE COUNTER

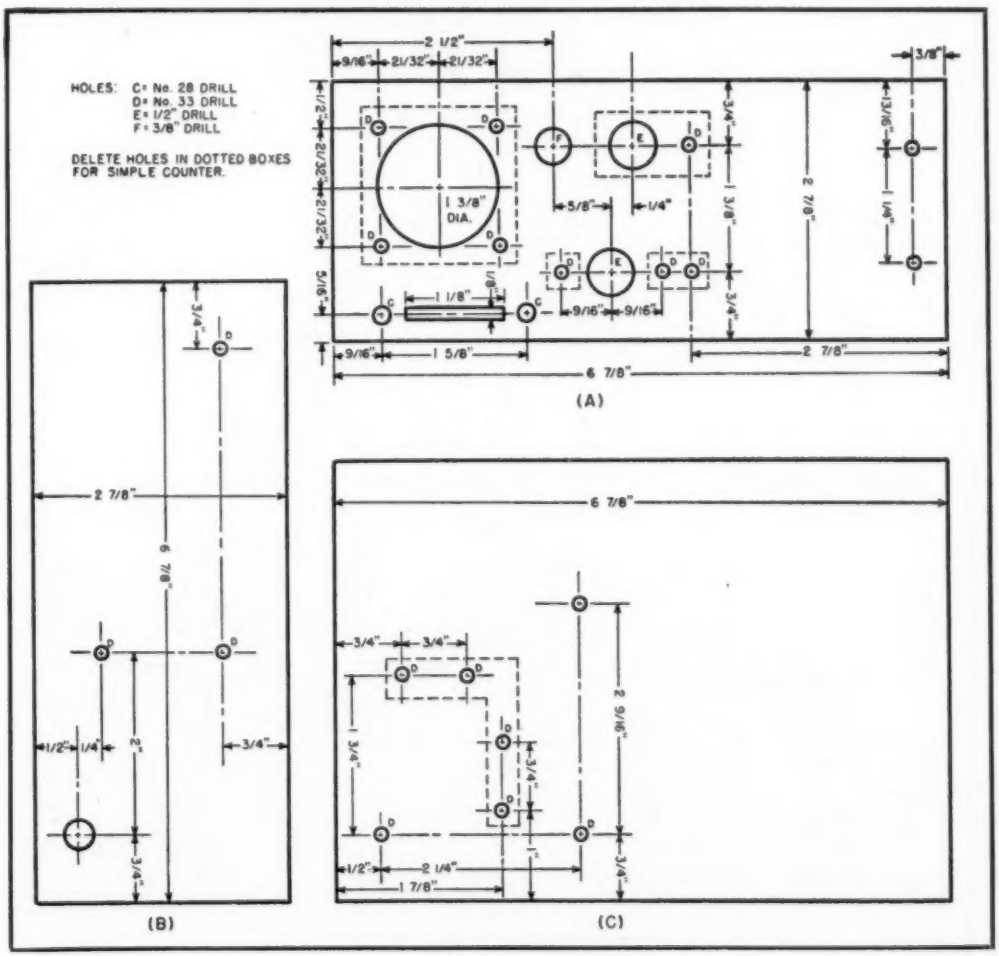
R1—8.2 megohm, ½ w. res.
C1, C2—1 μfd., 600 v. paper capacitor (Aerovox Aerolite Type P82)
C3—.01 μfd., 2000 v. disc ceramic capacitor (Centralab Type MD 103)
S1—4 p., 2 pos. non-shorting spring return lever action sw. (Centralab Type 1457)
S2—S.p.s.t. toggle sw.
V1—Geiger tube (Amperex 75NB3)
J1—Midget open-circuit jack
B1—67½ v. battery (Burgess XX45, RCA VS106, Eveready 467)
B2—300 v. battery (Eveready 493, Burgess U200)
1—Three-contact microphone connector (Amphenol 91-MC3F)
1—4⅝" length of ⅞" o.d. fiber tubing
1—Aluminum cabinet, 3" x 5" x 7" (ICA Type 29343, Bud CU 2108)
1—5' length of self-retracting, 2-conductor cord (conventional 2-conductor cable may be used with a spring retractor)
2—Spring clips for tube mounting (Mallory TH-19)
1—Battery plug for B1 (Cinch-Jones 5MFA)
2—Banana plugs for B2 (Johnson Cat. 108-750)
2—Five-contact terminal strips (Cinch-Jones #2005)
1—Pair headphones (2000 ohms)
Misc. screws, nuts, wire, solder
Total cost, approx. $29.00

ADDITIONAL PARTS FOR DE LUXE UNIT

R2—10 megohm, ½ w. res.
R3—2200 ohm, ½ w. res.
C4—.01 μfd., 250 v. miniature disc ceramic capacitor
C5—.05 μfd., 200 v. paper capacitor (Aerovox Aerolite Type P82)
C6—100 μfd., 6 v. electrolytic (Aerovox Type SRE Bantam)
CR1—1N34 crystal diode
T1—Reactor (primary of miniature output transformer such as UTC "Ouncer" Type O-9; see text)
S2—D.p.d.t. slide sw., H & H 1182; replaces S2 on simple unit
B3—Two 1½ v. size C flashlight cells in parallel
V2—Type 1S4 tube
PL1—NE51 neon lamp, socket and jewel
M1—0-500 microampere meter (Marion Type HS1-1½, DeJur 1½" Model No. 112); a 0-1 ma. meter may be used, or meter omitted entirely—see text
1—7-pin miniature tube socket
Total additional cost, approx. $15.00, assuming that a surplus meter may be obtained

NOTE: Parts having similar mechanical and electrical specifictions may be substituted for the parts specified.

Fig. 3. Layouts for (A) meter panel, (B) panel with tube clamps, and (C) rear panel.



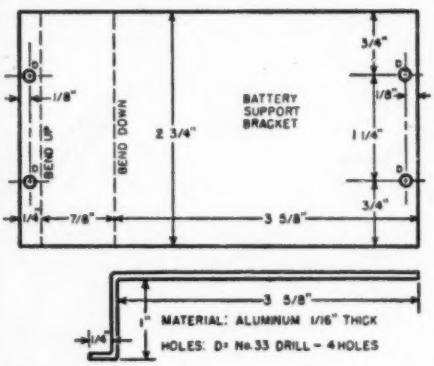


Fig. 4. Bracket for B3 compartment and for supporting the battery terminal plate.

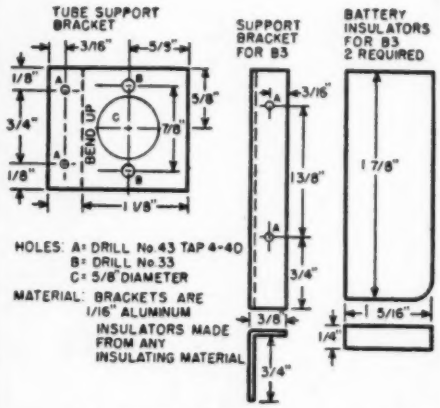


Fig. 5. Details of tube support bracket, B3 support bracket, and insulators for closing the B3 battery compartment.

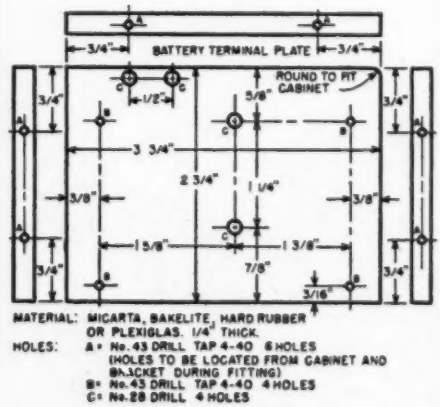

BATTERY TERMINAL PLATE
ROUND TO FIT CABINET
3 3/4"
2 3/4"
1 1/4"
1 5/8"
1 3/8"
7/8"
MATERIAL: MICARTA, BAKELITE, HARD RUBBER OR PLEXIGLAS. 1/4" THICK.
HOLES: A= No.43 DRILL TAP 4-40 6 HOLES (HOLES TO BE LOCATED FROM CABINET AND BRACKET DURING FITTING)
B= No.43 DRILL TAP 4-40 4 HOLES
C= No.28 DRILL 4 HOLES

Fig. 6. Construction of the battery terminal plate which supports the banana jacks for B1 and the terminal strips.

understanding of the design of these radiation-detecting instruments.

Certain materials, notably radium, uranium and thorium, are "radioactive," a term applied to a material whose atoms disintegrate spontaneously with the emission of alpha, beta, and gamma rays. For prospecting, gamma rays are of prime interest since they have the greatest range and penetrating power.

A Geiger tube is essentially a gas-filled diode. Typical construction consists of a cylindrical metal cathode with an axially located center wire which serves as the anode lead. A high voltage is applied to these electrodes, the anode being positive with respect to the cathode. This voltage is not sufficient to produce ionization within the tube, so normally no current flows. However, if an electron is introduced into the space between the anode and cathode, it will be accelerated enough by the high voltage to ionize the gas, thus producing a sharp pulse of current through the tube. Because of the quenching action of the gas, the current will cease as soon as the discharge has been completed. The pulse of current is then either used directly or amplified and caused to produce a click in a pair of headphones, a flash of a neon lamp, or a deflection on a meter.

The electron to initiate the discharge described above can be produced by a gamma ray striking the wall of the tube. The number of electrons thus produced depends directly on the intensity of the gamma radiation, and so the number of pulses of current per unit time in the tube is likewise a measure of radiation intensity.

In the instruments described here, an *Amperex* Type 75NB3 Geiger tube is used which requires 700 volts for normal operation. The outer wall, or cathode, is of stainless steel about .010" thick, sufficient to screen out all alpha and beta rays. Halogen quenching, a term which describes the gas used in the tube, is employed. With such quenching, the tube has an almost infinite life and is not damaged by moderate voltage overloads.

A novel scheme (Fig. 1) is used to produce the required 700 volts. The battery supply consists of a 300-volt and a 67½-volt battery in series, giving about half the required voltage. A trick switching arrangement is employed; in one position a capacitor is connected in parallel with the battery and charged to the full 367½ volts, while in the other position this capacitor is connected in series with the battery to produce a total voltage of 735 volts, sufficient to operate the Geiger tube. Switching is accomplished by a spring-return

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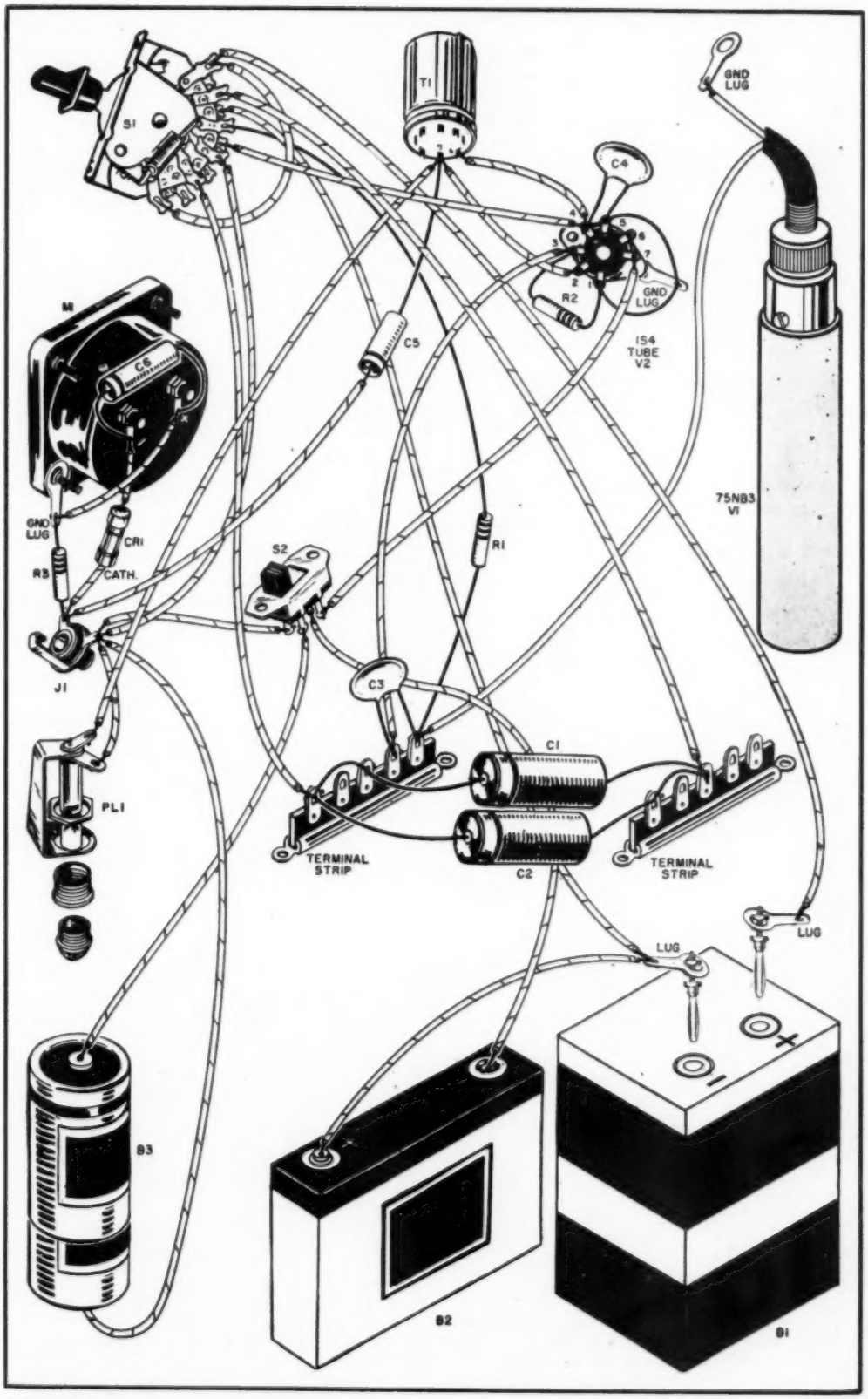
Pictorial diagram of de luxe unit.


S1
T1
GND LUG
C4
M
C6
C5
GND LUG
R2
IS4 TUBE V2
75NB3 V1
GND LUG
CR1
CATH.
R3
S2
R1
J1
C3
C1
PL1
TERMINAL STRIP
C2
TERMINAL STRIP
LUG
LUG
B3
B2
B1

switch which charges the capacitor and upon release connects it in series with the battery. A capacity of two microfarads (*C1* and *C2* in parallel) is sufficient to operate the tube for several minutes.

The pulses of current resulting from ionization in the Geiger tube pass through resistor *R1*, producing a voltage pulse which is coupled through *C3* to a pair of headphones or to an amplifier.

The headphone signal in the simple unit is rather weak, and many prospectors desire an indication of radioactivity on a meter and a neon flasher, as well as a louder headphone signal. These are all provided in the de luxe version (Fig. 2).

Signals from the Geiger tube are impressed on the grid of a 1S4 amplifier tube, *V2*. Filament power is provided by two parallel-connected flashlight batteries, *B3*, and plate voltage is obtained from the 67½-volt battery, *B2*, by means of a third section on switch *S1*. The primary of an audio transformer, *T1*, serves as the load for this amplifier, and capacitor *C4* is the screen bypass. Amplified pulses are coupled to the meter and headphone circuit through *C5*.

T1 serves another purpose. It provides an inductive kick sufficient to light the neon tube *PL1* whenever a count is received. If the flasher is not considered necessary, *T1* may be replaced by a 47,000-ohm, ½-watt resistor, reducing the over-all cost somewhat.

The amplified pulses are rectified by the crystal diode *CR1*, and the rectified current flows through meter *M1*. Although a 0-500 microampere movement is specified, a more sensitive meter could be employed. Similarly, a 0-1 ma. movement could be used, although a "hotter" ore sample would then be necessary to "pin" the meter. The important thing is to obtain a unit that will fit in the available space. It might be well to check "surplus" ads for a suitable meter. The meter, *CR1* and *C6* can all be omitted if a suitable meter cannot be obtained. A larger cabinet would permit the use of a larger meter. Resistor *R3* is included to provide a complete circuit for the crystal diode so that the meter will operate satisfactorily if headphones are not plugged in or if crystal headphones are used.

Construction

A 3" x 5" x 7" aluminum cabinet serves as the over-all enclosure. Details for drilling this enclosure are given in Fig. 3; those portions enclosed in dotted lines are for the de luxe version only. The drawings of Figs. 4, 5, and 6 and the photographs indicate how the battery compartments are formed, drilled and installed.

A slide switch is used for *S2* in the de luxe version rather than a toggle switch to provide the necessary clearance for the neon lamp indicator and jewel. Figure 5 shows the construction of the socket mount, as well as the battery support and insulators for *B3*. Details on the battery terminal plate for *B1* and *B2* are given in Fig. 6.

The coiled cord for the probe was obtained from a war surplus hand microphone, but any two-conductor cable capable of handling 735 volts with very low leakage may be employed. Protection for the Geiger tube is provided by Bakelite or fiber tubing having a ⅞" outside diameter. This tubing may be threaded inside to fit the microphone connector, or can be fitted by filing the inside of the tube slightly with a rat-tail file and then screwing it onto the connector.

In wiring, capacitors *C1* and *C2* are first mounted on the terminal strips that are affixed to the Bakelite battery terminal board, and long leads are provided to make connections to the switches after the board is mounted. Switches and jacks are installed and the wiring connected to them. For the de luxe unit, the tube socket is wired next with *C4* and *R2* mounted directly on the socket. Leads are provided to connect to the switch and transformer. The meter and its associated *CR1* and *C6* are installed last.

A carrying handle or shoulder strap should be added for increased convenience. A strap may be made from webbing, a woman's plastic belt, or even from a dog leash.

Operation

To operate the counter, switch *S1* is closed and *S2* is moved momentarily to the "charge" position, then allowed to spring back into place. A background count of about 30 or 40 clicks per minute should be heard in the headphones. This rate will increase rapidly if radioactive material is brought near the probe. After a few minutes, possibly as much as half an hour, the clicks will become weaker. At this point, *S2* should again be flipped momentarily to the "charge" position and released, after which the instrument is ready for another period of normal operation.

The serious prospector should by all means obtain copies of two government publications, entitled "Prospecting for Uranium" (55 cents) and "Prospecting With a Counter" (30 cents). These publications can be obtained from the Government Printing Office, Washington 25, D. C. They contain a wealth of valuable information about prospecting as well as about bonuses available from uranium strikes. With the two books and a Geiger counter, prospecting will be a snap. —30—

Books on Uranium Prospecting and Counting Equipment

"ATOMIC RADIATION DETECTION AND MEASUREMENT" by Harold S. Renne. Published by Howard W. Sams & Co., Inc., Indianapolis, Ind. 192 pages. Price, $3.00. Paper bound.

Interest in the many aspects of nuclear science is growing by leaps and bounds. Such aspects as uranium prospecting, civil defense, atomic power, nuclear reactors, and the uses of radioactive isotopes are receiving widespread publicity in newspapers, magazines, and on radio and TV programs. These developments have served to emphasize the need for a basic, comprehensive book on nuclear science, with particular emphasis on the detection and measurement of atomic radiation.

Such a book is now available under the above title. The material is written in a semi-popular vein, and for the most part can be understood by anyone who has had the equivalent of a good high school course in basic science. Some knowledge of electronic circuitry would be helpful for certain portions.

The first three chapters are devoted to a review of basic atomic and nuclear knowledge, including radioactivity, radiation, effects of radiation, atomic fission, and the like. Chapters 4 and 5 discuss Geiger and scintillation counters in considerable detail, and include schematic diagrams and operating principles of a number of commercial units. Several home-built counters of both the Geiger and scintillation type are described in Chapter 6. Chapter 7 covers dosimeters, and the following three chapters present a great deal of information on applications of atomic radiation, civil defense, and prospecting for uranium.

To guide the reader further, several appendices have been added—a manufacturer's directory, glossary of terms and abbreviations, and an extensive bibliography. All in all, this book will be of tremendous interest and value to anyone working in any of the various phases of the nuclear science program, including civil defense and prospecting, or to anyone interested in learning more about this fascinating subject.

"URANIUM OFFICIAL YEARBOOK." Published by *New Science Institute,* 5204 Santa Monica Blvd., Los Angeles 29, Calif. Photo-offset, 82 pages plus heavy paper cover. Price, $2.00.

This interesting book is the first of many books on uranium prospecting that will appear before the close of the year. From the strictly "prospecting" viewpoint, the reader who lacks any background knowledge of how, why and where will want to keep this book handy. Besides illustrating a number of successful cases (including the "Miracle Mine" mentioned in the article on pages 17-20 of this issue), there is information on likely uranium areas throughout the continent, detailed descriptions of the various uranium-bearing orés, the best prospecting methods—on foot, car, motorscooter, heliocopter, etc.—and necessary equipment, and how to stake and file a claim. For a general background, plus a little of the "romance" and adventure in uranium prospecting, this book is very worthwhile.

"THE URANIUM PROSPECTOR'S GUIDE" by Thomas J. Ballard and Quentin E. Conklin. Published by *Harper & Brothers,* 49A East 33rd St., New York 16, N. Y. 251 pages, including glossary, index and appendix. Hard cover. Price, $3.50.

"The Uranium Prospector's Guide" was written by two working authorities in the field of uranium prospecting and mining. Both authors are currently employed as mining engineers by the *Uranium Prospectors Co., Ltd.,* in Grand Junction, Colo. As a result, their book is undeniably the most thorough approach to the subject that has appeared in print.

Unlike the "Yearbook" reviewed above, which would appeal to the *Sunday* prospector, the "Guide" is for the serious prospector who wants information on mining law, mineralogy, claim staking, ore estimation, development of deposits, etc. The authors also contacted other specialists who prepared chapters on Geiger counting equipment and the utilization of maps.

The book closes with an extensive glossary prepared by Karl Kuhe, AEC geologist; references to books and magazines on mining; and finally, a seven-part appendix of important AEC documents. Amateur prospectors making a $100 investment (or more) in Geiger counting equipment will do well to buy this book—it has all the answers.

—30—

THE SCINTILLATION COUNTER

By ED BUKSTEIN

Learn how this device operates and how it can be used in the detection and measurement of atomic radiation of all kinds.

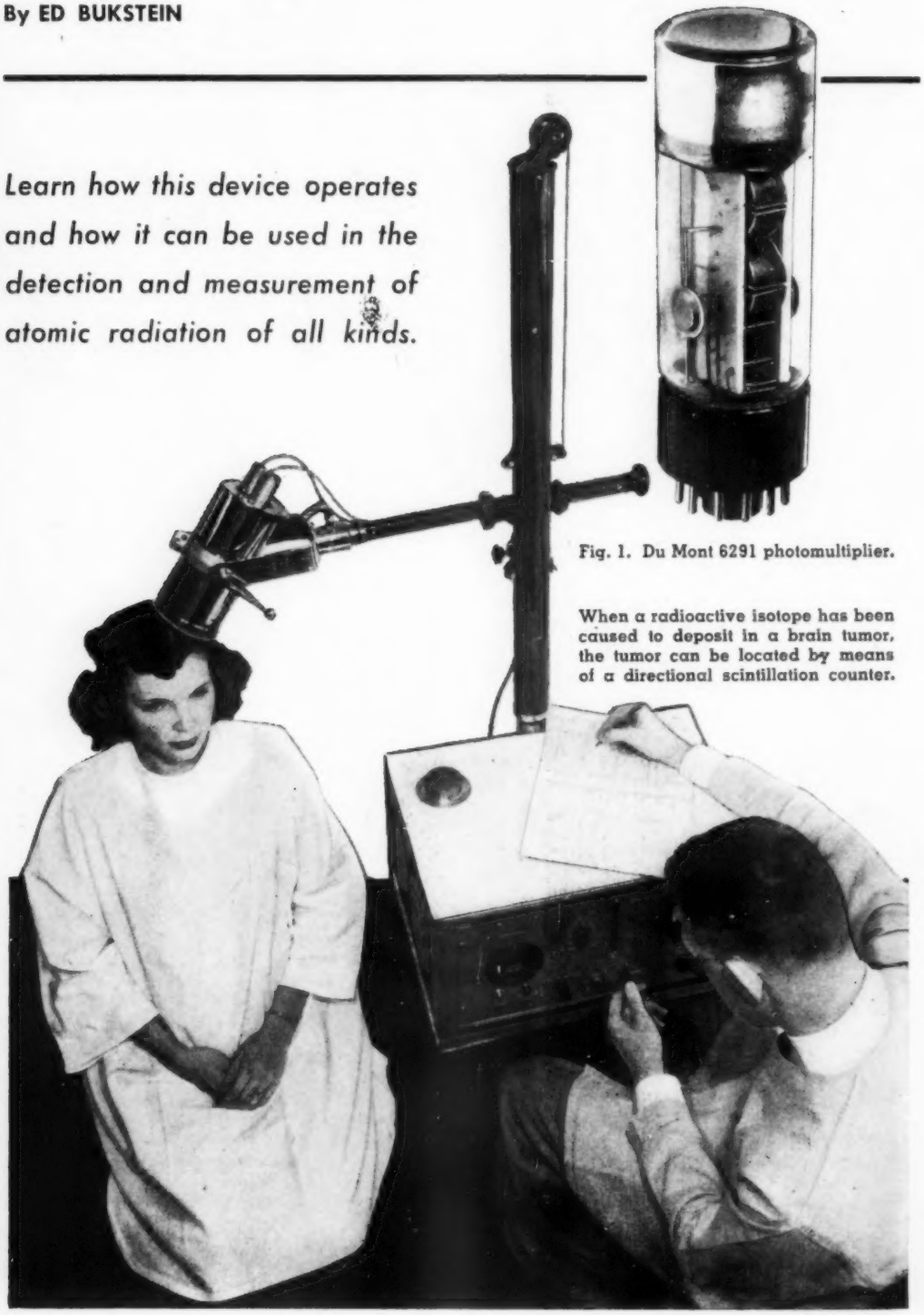


Fig. 1. Du Mont 6291 photomultiplier.

When a radioactive isotope has been caused to deposit in a brain tumor, the tumor can be located by means of a directional scintillation counter.

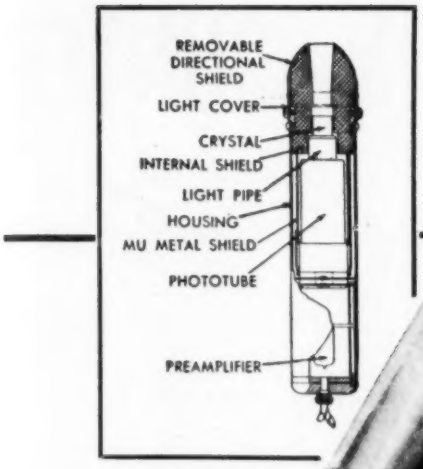
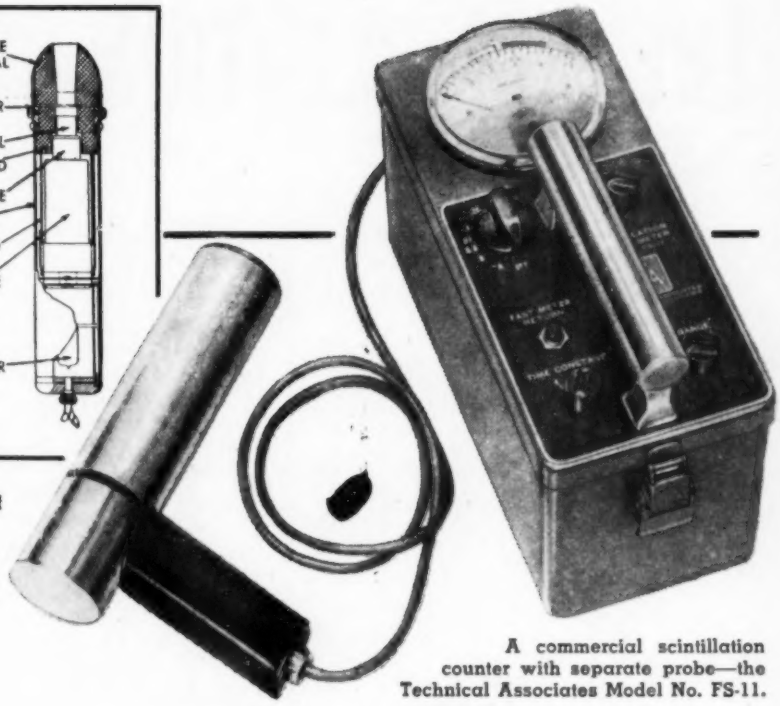


Fig. 2. Cross section of typical scintillation counter. See text.



A commercial scintillation counter with separate probe—the Technical Associates Model No. FS-11.

THE scintillation counter, like its famous cousin the Geiger counter, is used to detect radioactivity. Both instruments "count" the particles thrown off by radioactive substances. These counts can be indicated on a meter, as clicks in a headphone, or as flashes of a neon bulb. Because of its greater sensitivity and accuracy, the scintillation counter is rapidly replacing the Geiger counter in the field as well as in the laboratory. So sensitive is the scintillation counter that it can be used for prospecting from an airplane or for measuring the natural radioactivity still remaining in a mummy case from ancient Egypt.

Although the electronic circuits are new, the basic idea of scintillation counting has been known for over half a century. The scintilloscope, forerunner of the modern scintillation counter, was first constructed in 1903. This device was made up of a hollow tube with a magnifying lens at one end and a screen of zinc sulfide at the other. When brought near a source of radioactivity, the zinc sulfide produced a brief flash of light each time it was hit by one of the particles ejected from the radioactive substance. An observer, looking through the magnifying lens, could see and count these flashes. In the modern scintillation counter, the flashes of light are counted by a phototube (electric eye) instead of the human eye.

Other chemicals, more suitable for this application than zinc sulfide, are now available. Thallium-activated sodium iodide is one of the current favorites. A plastic material called "Plastifluor" is finding widespread usage where large blocks of material are required, as in very sensitive airborne equipment. Also, some liquids exhibit scintillating properties, and are employed in special applications.

Because the flashes of light produced in the scintillation counter are of low intensity, a very sensitive type of phototube is required. This tube, known as a photomultiplier, is shown in the photograph of Fig. 1. The photomultiplier has a light-sensitive cathode which emits electrons each time it is illuminated. These electrons are attracted in succession to a number of dynodes before they eventually arrive at the plate, as illustrated in Fig. 3. When electrons from the cathode strike the first dynode, they knock out secondary electrons. These are then attracted to the second dynode where they release still more secondary electrons. Since a dynode emits several secondary electrons for each electron striking it, the number of electrons is increased at each dynode and a great many ultimately reach the plate. In this way, a single electron from the cathode can start an avalanche of electrons and, consequently, produce a considerable amount of plate current.

Each dynode of the photomultiplier is operated at a higher positive voltage than the preceding one so that the electrons will

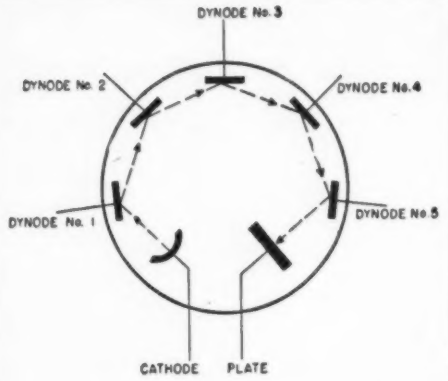


Fig. 3. Diagram showing basic photomultiplier action. Electrons from the cathode go in succession to each dynode before reaching the plate.

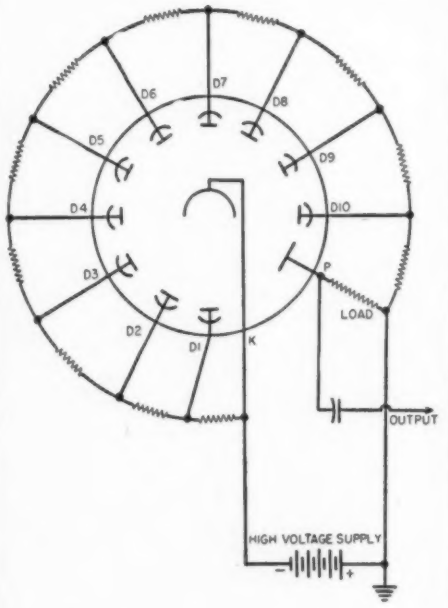


Fig. 4. A voltage divider proportions the available voltage to provide an increase of about 100 volts per dynode.

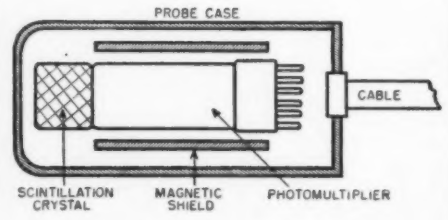


Fig. 5. Scintillation probe assembly.

go from dynode to dynode in the right order. Electrons from the last dynode are attracted to the plate and then flow through a load resistor to produce the output. Each time a flash of light illuminates the cathode of the photomultiplier, a pulse of voltage appears in the plate circuit. These pulses are amplified and then applied to a headset, neon bulb, counting rate meter, or other indicating device. Since each dynode must be made more positive than the one before it, a high voltage power supply is required. Common values for this supply range from 1000 to 1500 volts. As shown in Fig. 4, a resistive voltage divider proportions the available voltage to provide an increase of about 100 volts per dynode. The plate, of course, is the most positive element since it must collect the electrons from the last dynode.

In photomultipliers designed for scintillation counting, the cathode is in the end of the tube opposite the base. This feature, known as a head-on cathode, simplifies construction when the tube is to be used in a probe. A typical probe construction is shown in Fig. 5. To shield the photomultiplier from sources of illumination other than the scintillation crystal, the probe case must be light-tight. However, it must permit the radiation that is to be detected to pass through to the crystal. Thin aluminum is often used for the probe case. An additional shield protects the tube from external magnetic fields.

The cost of a scintillation counter is, in general, considerably more than that of a Geiger counter, partly because the scintillation crystal-photomultiplier tube assembly is a great deal more expensive than a typical Geiger tube. Power supply requirements are also greater. A Geiger counter seldom draws more than one microampere except in very strong radiation fields, whereas a scintillation counter may call for 20 microamperes or more. When high-voltage batteries are used, the additional drain is not a problem, but where the high voltage is generated electronically, more complicated and more expensive equipment may be necessary.

Figure 2 shows a cross-sectional drawing of a commercial scintillation counter, the *Nuclear-Chicago* Model DS-1. As can be seen, a removable lead shield can be employed to give the counter directional characteristics. Care must be taken in attaching the crystal to the face of the photomultiplier tube or to the "light pipe" which conducts light to the tube, since any loss of light results in decreased sensitivity. Usually, a silicone grease serves to join the various components, and lucite or a similar plastic material is used as the "light pipe."

—30—

Build an ELECTROSCOPE

Early experimenters used this device to detect presence of electricity and static charges.

By RUFUS P. TURNER

THE electroscope is one of the oldest electrical instruments. William Gilbert built one in the year 1600. Nevertheless, it is still a useful device. It is easy to build, and many interesting experiments can be performed with it.

An electroscope consists simply of a small strip of gold leaf, one end of which is attached to a metal plate of about the same size. The leaf hangs parallel to the plate and may even rest against it. This assembly is then attached to a metal rod and enclosed in a glass jar. It can be seen from the outside but will be protected from drafts of air. The metal rod protrudes and permits external connections.

Ordinarily, the leaf hangs close to the plate or in contact with it. But when an electrically charged body is brought close to the rod, the leaf stands out, away from the plate. The distance it moves depends upon how strong the voltage of the charged object happens to be. The leaf remains lifted as long as the charged object is kept in position, or as long as the object remains charged. It may remain lifted even after the body is removed, if the electroscope has been charged. When the electroscope is discharged, by "shorting" it momentarily to the earth, the leaf will fall.

This action occurs because the electrified body charges the metal plate and the gold leaf by induction. Since the leaf and the plate are attached together, they receive the *same* sort of charge, i.e., positive or negative. And since a basic law of electricity is that like charges repel each other, the light gold leaf is repelled by the plate.

The electroscope consumes no current

One of the simplest measuring instruments may be easily constructed in a few minutes.

while indicating the presence of electrons. Furthermore, it requires only one connection to a circuit, and often no direct connection at all.

How To Build It

Building an electroscope requires a small glass jar, a small strip of gold leaf, and a few odds and ends from the junk box. Figure 1 shows details of construction.

Make a small metal bracket, as shown in Fig. 1C. Any convenient non-magnetic metal such as aluminum, brass, or phosphor bronze will be satisfactory. To make the bracket, cut a 1⅛" x ⅜" strip. Drill a clearance hole for a *6-32* bolt (# 28 drill) 3/16" from one end and 3/16" from the side of the strip. Finally, make a right-angle bend to form the bracket.

The next step is to cut a ⅝"-diameter clearance hole in the center of the metal jar top. (See Figs. 1A and 1B). There is no objection to making this hole larger, but it should not be smaller than ⅝". To cut the hole, the author used a radio socket punch. If a plastic jar top is used, the hole will not be required. The pickup electrode of the electroscope consists of a 2"-long *6-32* bolt, and the purpose of the clearance hole is to insulate the bolt from the metal jar top. This bolt is supported by a small square of polystyrene (1¼" square) fastened to the inside of the jar top with four small *3-40* bolts and nuts, as shown in Figs. 1A and 1B. A clearance hole (#28 drill) in the center of this square passes the 6-32 bolt.

Assemble the electrode bolt, insulating plate, and metal bracket on the jar top. Tighten all of the nuts securely. After assembly, polish the long surface of the bracket with fine sandpaper until it is bright. Then scrub the surface with soap and hot water to remove all dirt and grease. Wash off the soap, rinse the bracket several times in clear water, and dry thoroughly. From this point on, do not touch the bracket with the fingers; do not allow it to come into contact with any oil or grease; and do not breathe on it. The reason for this cleanliness is that the gold leaf, which will be attached next, will stick to the bracket if the latter is the least bit dirty, and the electroscope will not work.

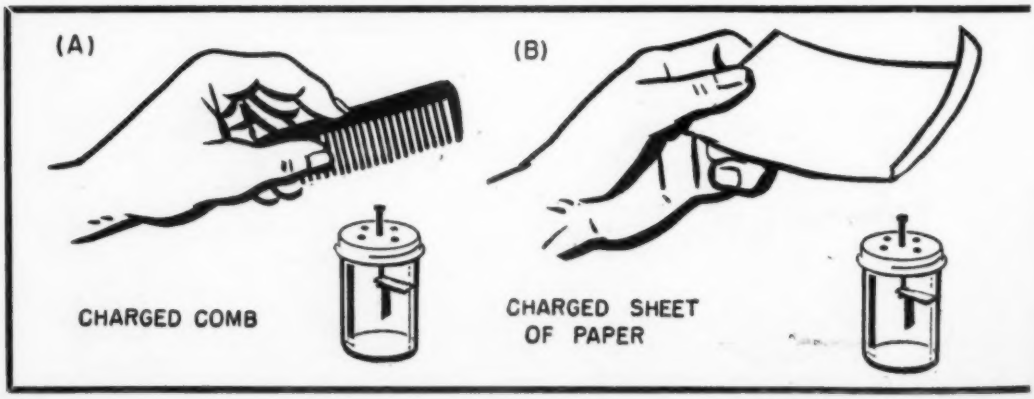
Now attach the gold leaf. Gold leaf is exceedingly light and thin and must be handled in a draft-free room. During this operation, close the windows and doors and tie a handkerchief or mask around nose and mouth to prevent blowing the leaf out of shape. Gold leaf comes in a book of sheets with separating pages of tissue paper. It can be bought from a sign painters' supply house. Pull out a leaf with a tissue page on each side and lay this "sandwich" on a sheet of flat cardboard. Then, with a sharp razor blade or *Exacto* knife, cut through the tissue paper and gold leaf to obtain a strip ¾" long and ⅜" wide. With a clean wooden toothpick, remove the top layer of tissue paper, exposing the gold leaf. Then, spread a thin strip of *Duco* cement (about 1/16" wide) along the upper bend of the bracket; this area is shown by the shading lines in Fig. 1C. Before the cement has chance to dry, lift the assembly by the jar top and quickly press the cemented edge of the bracket against the tip of the gold leaf strip. This procedure will attach the leaf to the bracket. Screw the top on the jar, and the electroscope is completed.

When the jar rests on its bottom, the gold leaf should hang against the bracket. As the jar is tilted, the leaf should swing away from the bracket. If it sticks to the bracket, the latter has not been thoroughly cleaned, and must be cleaned again.

Electroscope Experiments

An electroscope indicates the presence of an electric charge just as a magnetic

These four drawings illustrate basic experiments that may be performed with the simple



needle will show the presence of a magnetic field. When the electrode of the electroscope is touched to an electrically charged object (or, in some cases, simply brought near it), the gold leaf will move away from the metal bracket. High voltages will swing the leaf over the greatest distances.

Try combing the hair briskly and then bringing the charged comb near the pickup screw. See how the gold leaf rises to show the presence of static electricity. A glass rod rubbed with a silk cloth will give the same effect. Static electricity can also be generated by laying a dry sheet of typewriter paper on a highly polished desk or table, or on the cover of a magazine having a glazed surface (like POPULAR ELECTRONICS), and rubbing the paper vigorously with a wooden pencil. When the paper is lifted, it will be highly charged; and when brought to the electroscope, it will deflect the gold leaf. Shuffling feet across a rug, and then touching the pickup screw with a finger will result in a high voltage swing of the leaf. A hairy brush or broom after stroking a floor or polished table top likewise acquires a considerable charge of electricity. In some localities, however, it is hard to generate static electricity in any of the ways just described unless the weather is cool and dry. Humid days often tend to ruin the experiments.

When the electroscope pickup is touched to *one* terminal of a power supply or high voltage battery, the leaf will be deflected. Three hundred volts d.c. will move the size of leaf shown in this article through 45°. Similar leaf movement is obtained when the screw is touched to one terminal of a charged capacitor.

Electroscopes sometimes are used in industry to detect static charges on paper, photographic film, cloth, plastic sheets, machinery belts, etc. They have been used in surgical operating rooms and around oil trucks for the same purpose.

A "hot" piece of radioactive ore has been observed to discharge a previously charged electroscope. However, don't expect to take this instrument on a prospecting trip in place of the more expensive Geiger counter. It just is not sensitive enough or rugged enough for such an application. —30—

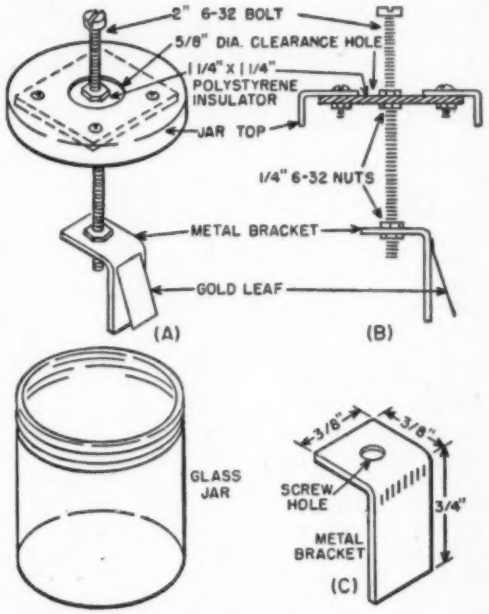
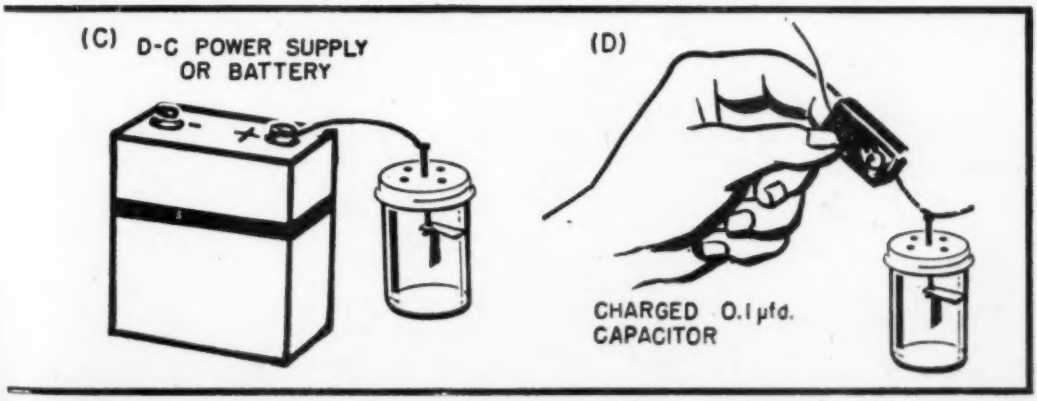


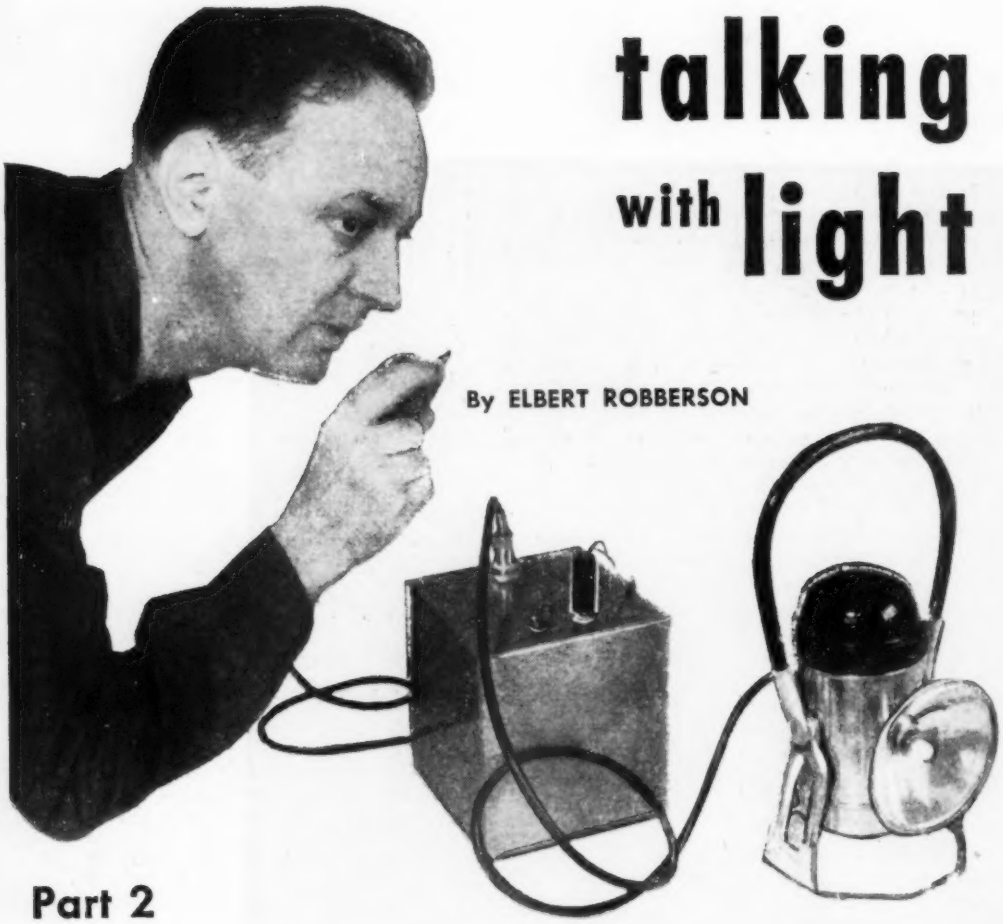
Fig. 1. In assembling the electroscope, the author used an empty peanut jar. The cardboard insert in the lid is removed and a hole is cut in the center of the metal lid. A small square of polystyrene is then mounted under this hole and a 2"-long bolt fastened through the center. At one end, mount the metal angle bracket shown in (C). Glue the gold leaf to the bracket just beyond the bend as shown in (A) and (B).

electroscope. Many others may be carried out with this device. See text for suggestions.



talking with light

By ELBERT ROBBERSON



Part 2

LAST MONTH a photo-electric "receiver" for light-beam communication was described. Here is a portable light-beam "transmitter" to go with it. Aim it at the receiver, talk into the microphone, and the party at the other end of the beam will get the message. It can be lugged out in the field or used between fixed locations. This is one system which is pretty secure against "tapping."

To be fancy, the light-beam transmitter could be called an "amplitude-modulated light projector." But getting right down to cases, all it amounts to is a microphone, an amplifier, and a portable searchlight. The whole unit, except for the microphone and searchlight, can easily be built into a 6" x 6" x 6" aluminum utility box.

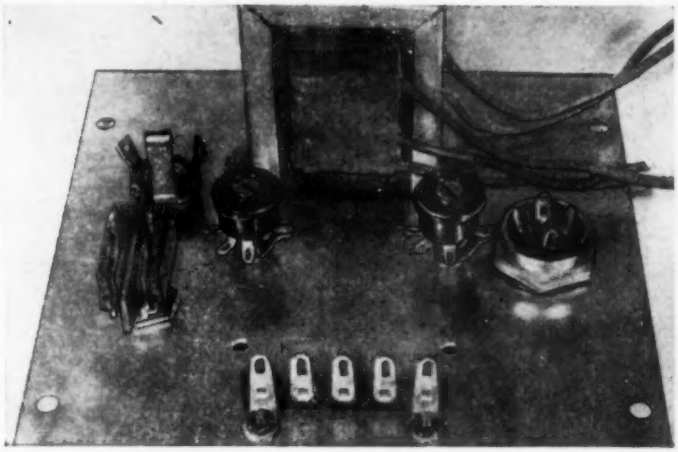
The searchlight is one of the many portable units on the market using a self-contained 6-volt dry battery. This particular model has a flashing red light built in, but this feature is not required. Just be sure that the searchlight chosen has a good reflector, giving a compact beam. In making a selection, shine the light on a flat white surface 15 or 20 feet away, and choose the unit with the smallest and sharpest pattern.

Miniature 3A4 tubes in a single-stage push-pull transformer-coupled amplifier are used to boost voice power to a level of about two watts. When this voice power is fed in series with normal battery power to the searchlight, its alternations buck and bolster lamp current. This causes the light output to flicker in time with voice vibrations. The lamp power in the unit shown amounts to two watts, so the 3A4 portable amplifier modulates the light beam to fullest capability without the necessity of shouting in the microphone. Normal conversational tones cause very little flicker, although the light brightens at a whistle. But whether the flicker can be seen or not, the light beam carries plenty of sound.

For the sake of simplicity and portabil-

Continued from last month, this concluding part describes the step-by-step construction of a light-beam modulator.

Tube sockets are flush-mounted on metal spacers which may be purchased from a local jobber or cut from copper tubing.



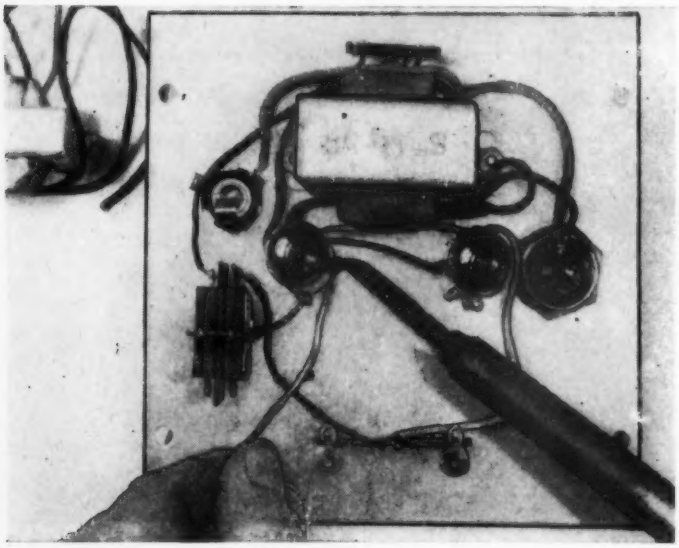
This chassis has been partially assembled for wiring. Socket S01 is at the right, with the input transformer, T1, at rear.

ity, battery power is used for the power supply of the transmitter. A single 1½-volt battery furnishes filament power, while three small 45-volt units in series provide screen and plate high voltage. The lamp's self-contained 6-volt battery is also used to supply the microphone and negative grid bias for the amplifier tubes. See Fig. 1 for entire circuit.

The layout of mounting holes for the various components is shown in Fig. 2. This view is of the bottom, or working side. All holes, except for the switch, jack, and lamp socket, are bored with a #25 twist drill, then deburred with the point of a pocket knife. Larger holes can be bored with a twist drill of the proper size held in a carpenter's brace; or smaller holes may be enlarged as required by reaming or filing with with a round file. A hole saw or chassis punch will make the ⅞"-diameter hole.

Tube sockets are the first components to be mounted. These are supported off the mounting surface by tubular spacers, ½" long. They may be purchased or cut from ¼" copper tubing with a hacksaw or tubing cutter. Cut the ends squarely so that the tubes will be level and not rock. After cutting, ream out the internal burr with a pass of a #14 twist drill. Assemble the socket and spacer, and put a

Editor's Note: In the first part of this story, which appeared in the June issue, the author described a light-beam receiver. This circuit used a 930 phototube, two small battery filament amplifier tubes, and two printed circuits. Thus, the coupling problem between the amplifier stages was greatly reduced—as were the wiring and installation problems. For experimental purposes, the author also noted that music and speech may be transmitted over very simple 6- or 12-volt searchlights. For a copy of the June issue, send 25 cents to POPULAR ELECTRONICS, Circulation Dept., 64 E. Lake St., Chicago 1, Ill.



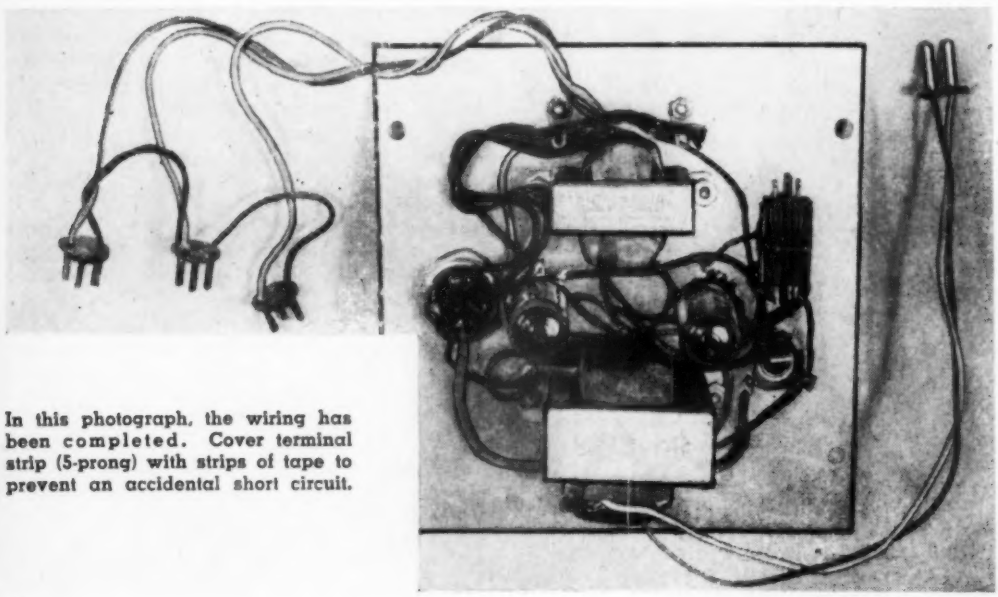
Do as much wiring as possible before installing the output transformer, T2. When looking down on the tube socket, the numbering is counterclockwise.

soldering lug underneath. Then the sockets should be fastened in the designated holes by a 1" *6-32* flat-head brass machine screw held by a nut on the other side. Orient the socket so that the pin terminals point in the directions shown in the pictorial diagram, Fig. 3. Bend the soldering lugs upward so that they meet the #1 terminals on both tube sockets, and bend all terminals outward for easiest connection.

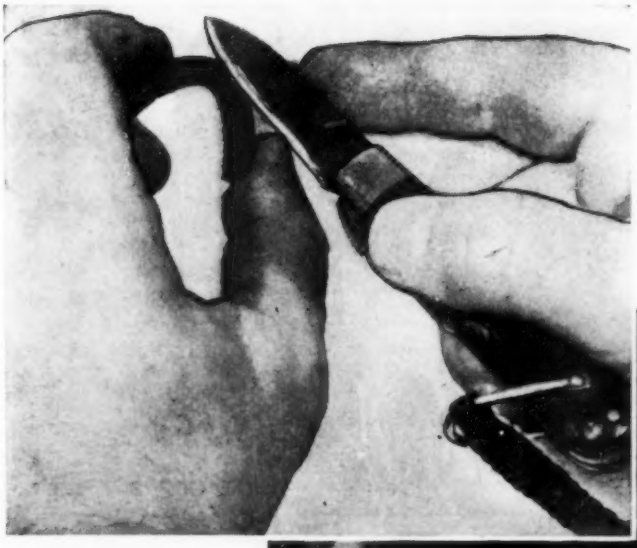
The remainder of the parts are secured conventionally by ¼" *6-32* round-head brass machine screws and nuts. At this stage, leave out the output transformer, *T2*, to give better working room.

Now the wiring can proceed. Figure 3 shows the routing of all wires. Although wire lengths are not critical, make connections fairly direct. As a connection is made, check it off with a red pencil on the wiring diagram.

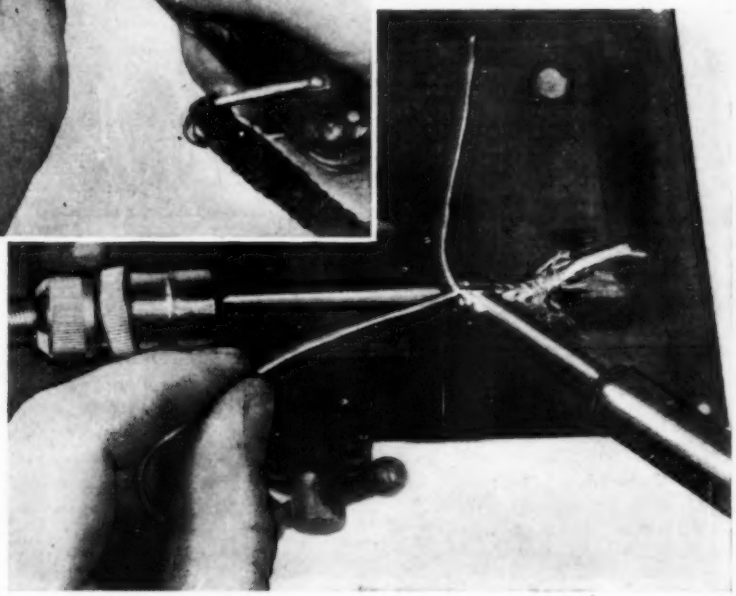
First, connect all grounds and jumpers. On both tube sockets, wire together pins #1 and #7 and solder in the ground lug. Pay particular attention to the fact that in this kind of "breadboard" construction one looks at the top of the tube sockets, rather than at the underside as is normal in a conventional "chassis," so that terminal numbers read counterclockwise.



In this photograph, the wiring has been completed. Cover terminal strip (5-prong) with strips of tape to prevent an accidental short circuit.



To remove cambric cover from shielded cable, carefully cut down to the metal braid completely around the cable. Grip the insulation with pliers and tear off, trimming edge if necessary. Sometimes it is easier to cut the cambric from the cable end to the circular cut and strip off.



Wrap a ground wire around the braided cable and solder the wire to the shield. Be careful not to use too much heat on the center insulation as the cable will melt and short out the circuit.

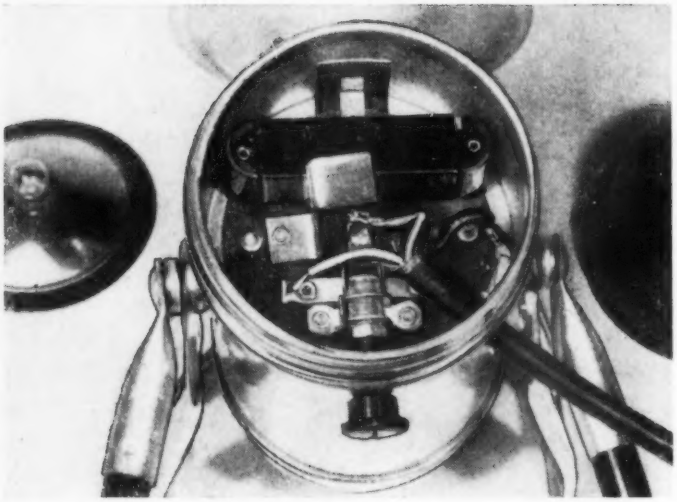
The 4-pole *Amphenol* 91-PC4F socket has terminal-identifying numbers stamped in the Bakelite. Strap the #4 terminal over to the grounded terminal #1 of tube socket *V2*. Then tie together the two center contacts, #1 and #4, of the "on-off" switch *S1* and connect across to the grounded terminal #7 of tube socket *V1*. It is not necessary to wire a ground for the sleeve terminal of the jack *J1*, as shown on the diagrams, since this is automatically taken care of by the construction of the jack.

To wire the filament circuit, run a wire from contact #2 of the small terminal strip to terminal #2 of the switch *S1*. Then connect contact #1 of the small strip to terminal #5 of tube *V1*, and a wire across to terminal #5 of *V2* as well.

Microphone transformer *T1* has one yellow primary wire connected to the tip terminal of *J1*, and the other to terminal #3 of *SO1*. At the same time, also connect the black transformer secondary center-tap wire to terminal #3 of *SO1*. Connect one secondary green wire to terminal #4 of *V1*, and the other to terminal #4 of *V2*.

Now, it is time for the high voltage. Wire in the necessary connections between the larger terminal strip and the sockets of *V1*, *V2*, and *SO1*. Install the output transformer, *T2*, as shown in the diagram. The blue primary wire is connected to terminal #6 of *V1*, while the brown wire goes to terminal #6 of *V2*. Extend the center-tap red lead to the larger terminal strip. On the output side of the transformer are the two black secondary leads. Connect them as shown to terminals #1 and #2 of the output socket *SO1*.

The microphone cord is provided with a PL-55 or headphone-type plug. To make the output cord, use a 4′ length of 4-conductor shielded and rubber insulated cord with #22 stranded conductors. Strip about 1″ of the outer sheath from one end, disassemble the *Amphenol* connector and slip the shell onto the cable. Next to the sheath, wrap one turn of #18 tinned copper wire around the shield braid, and solder all around. Then trim off the braid back to this point, skin the wires back ½″ and solder them in the plug terminal pins in



View of the cable connections inside the battery searchlight. Make sure of the polarity of the unit. Braid goes to the shell, white and black wires of the cable to the negative battery terminal, and red wire to the negative lamp terminal.

the order shown in Fig. 4. The plug can now be reassembled.

Drill a 9/32" hole in the shell of the searchlight as shown in the photograph, and put the other end of the output cord through. Then skin off the cable cover 2" back. With a dull-pointed tool, such as a nail or modified icepick, ravel out the shield braid into individual strands, exposing the cable conductors. Twist the shield strands into a wire, and slide over a piece of spaghetti insulation. In the lamp body, drill a #25 hole and secure a grounding lug with a 6-32 screw and nut.

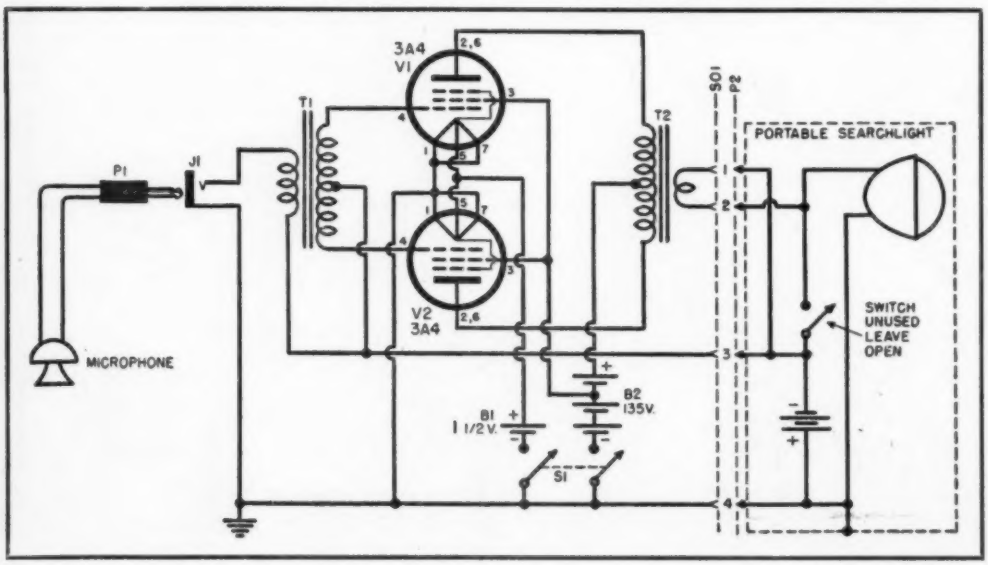
Then, solder the end of the shield braid to the lug. This "ground" should connect internally to the positive side of the lamp battery.

Twist together the black and white wires and solder them to the "hot" negative battery lead. The red wire goes to the center terminal of the lamp globe. Make sure that the exact polarity shown in the wiring schematic is maintained. If the schematic is not followed, the unit won't function and damage to the lamp could result.

With the cable connected, the lamp should still operate as before. Locate the switch position that turns off the lamp, and mark it so that it can be easily found after the unit is buttoned up. Put the lamp back together, and plug the cable into the amplifier. The searchlight should come on. To turn it off, unplug the cable.

Now the batteries can be connected, the microphone plugged in, and the switch

Fig. 1. (Below) Wiring schematic. Fig. 3. (Right) Pictorial wiring diagram.



B1—1½ v. battery, RCA VS004, or equivalent
B2—Three 45 v. batteries, Burgess XX30P1, or equivalent
J1—Single-circuit phone jack
SO1—4-prong microphone socket, Amphenol 91-PC4F
P1—Two-circuit phone plug
P2—4-prong microphone plug, Amphenol 91-MC4M
T1—Microphone transformer, Stancor A-4742, or equivalent
T2—Audio output transformer, Stancor A-3857, or equivalent
S1—D.p.d.t. toggle switch
V1, V2—3A4 tubes
2—7-pin miniature tube sockets
1—Utility case, 6" x 6" x 6", Premier PAC-666
3—45 v. miniature battery plugs
1—Single-button carbon microphone
1—2-prong terminal strip
1—5-prong terminal strip
1—"Handilite" 6 v. portable searchlight, or equivalent with narrow beam
1—4' length of 4-conductor shielded cable
Total cost of parts (less "Handilite"), approx. $14.00

Parts list for the light-beam modulator.

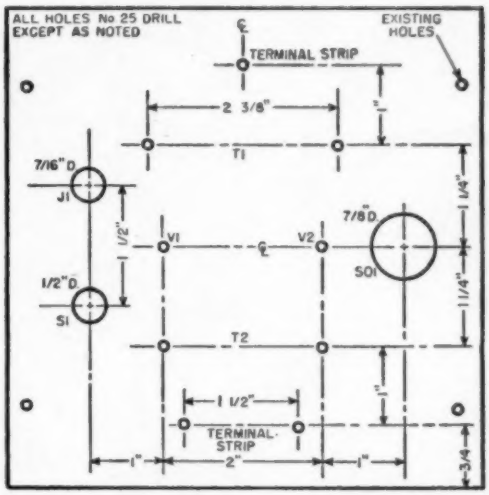
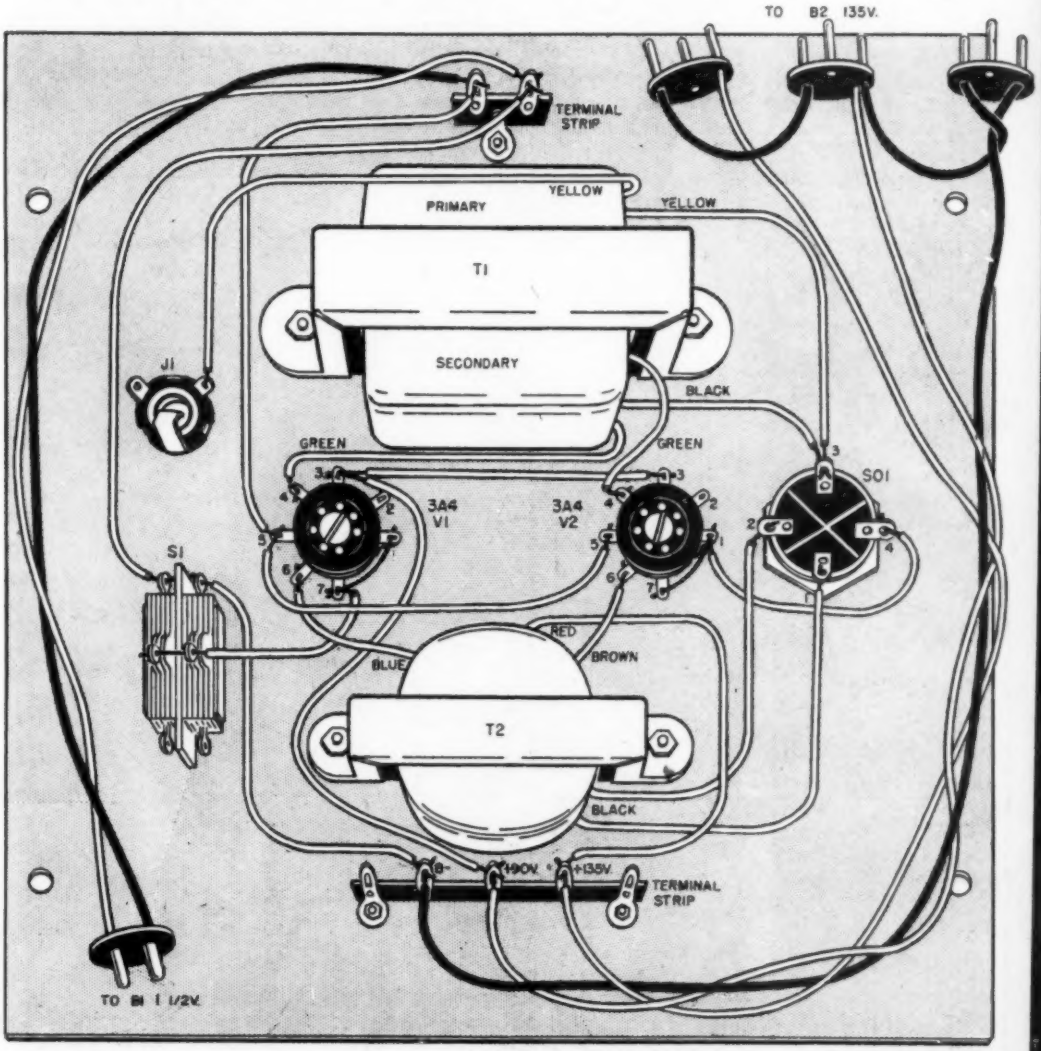


Fig. 2. Drilling template for chassis holes.



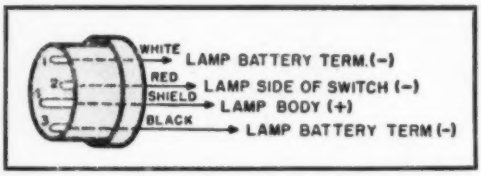
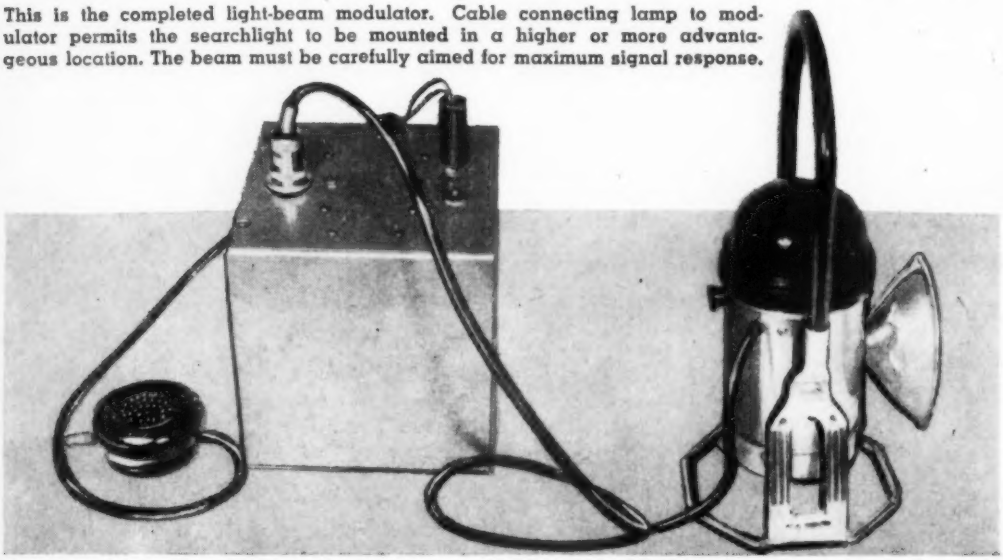


Fig. 4. Connections for plug P2 on the cable from the lamp to the modulator.

turned on. Whistling into the microphone should cause the searchlight beam to brighten. Aim the beam at the photocell of the light-beam receiver. The whistling should be heard loud and clear. In fact, all modulation with either voice or music will then be transmitted over the light beam. With two receivers and two transmitters, a communication link can be set up that will transmit clean-cut signals over distances of 50 to 100 yards in daylight and 150 to 300 yards at night.

The author has noted the recent release by the *Burgess Battery Co.* of its Model TW4 "Radar-Lite." This unit is claimed by the manufacturer to offer a 40,000 candlepower sealed-beam headlight which will cast a brilliant beam for over 800 yards. The circuit of this lamp could be easily modified and wired into the schematic shown on page 46. Use of this new product should result in much greater ranges. —30—

This is the completed light-beam modulator. Cable connecting lamp to modulator permits the searchlight to be mounted in a higher or more advantageous location. The beam must be carefully aimed for maximum signal response.



TO OUR READERS:

WITHIN THE past few months, a great many letters and postcards have been received requesting information on editorial policies, manuscript requirements, and special electronic circuits or installations.

As a general practice, sincere inquiries concerning material that has been published in POPULAR ELECTRONICS are answered as rapidly as possible. However, a huge volume of mail is received daily, and some questions may require research that does not enable the most expeditious answer. All letters, or postcards, are answered if they pertain to previously published articles.

The editorial staff is not in a position to make specific recommendations as to equipment that individual readers should purchase. Choice of such items depends upon a number of personal values which cannot be conveniently predicted. Also, the staff cannot recommend or suggest extensive modifications to previously published articles. We will make recommendations as to parts and component substitution where the indicated item is not immediately available, but drastic modifications often involve factors which we are totally unable to evaluate properly and correctly.

All manuscripts that appear in POPULAR ELECTRONICS under non-staff bylines have been purchased from authors. Our payment rates are among the highest in the field and are made upon acceptance of the submitted manuscript. We also pay for acceptable short items, including those that appear in "Tips and Techniques" and the small filler stories scattered throughout our pages. A submitted manuscript should be accompanied by return postage and envelope. Although we make every effort to handle material with care, we can assume no responsibility for submitted manuscripts. —30—

"NOBODY HERE BUT US TERMITES"

By ROBERT F. AMES

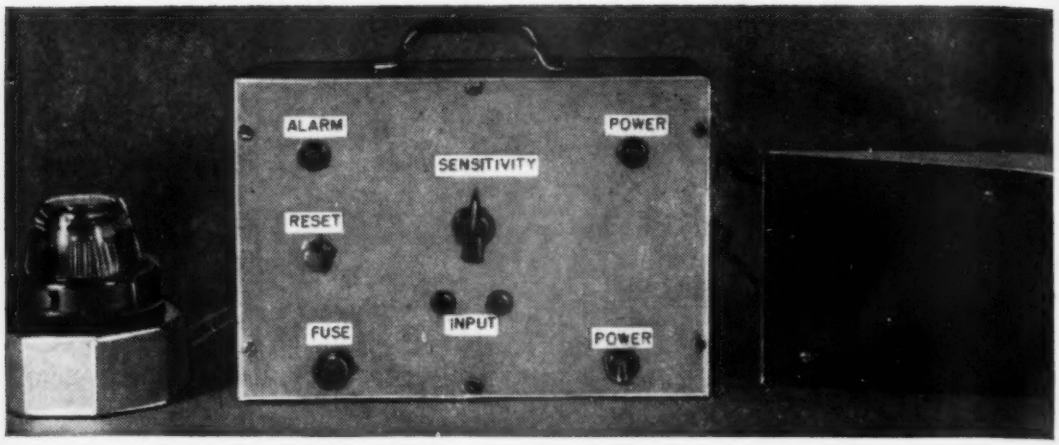
MILLIONS of dollars' worth of property may be saved by the use of a new electronic device to detect termites. These lowly, but relentless, foes of wood can now be discovered before they have had the chance to damage buildings. What gives them away is their own method of communication—which the new detector has revealed to be a series of "tom-tom" beats.

Developed by Roy J. Pence, entomologist at UCLA, the "Microsonic Detector" consists of three basic components. An extra-sensitive pickup is contained within a slender, needle-like probe. The needle-end of this probe may be pushed into any hard wood surface. It leaves only a tiny hole, but is sensitive enough to detect sonic vibrations made by the termites. The other end of the probe plugs into an amplifier—a small, high-gain, low-noise, frequency-selective unit. Battery-powered, it has a high receptivity to a limited band of frequencies in the over-all sound spectrum. This characteristic enables the operator to receive peak frequencies in the narrow range that contains the sounds made by termites. The operator listens to the pests via a headset connected to the output of the amplifier.

Besides its value in detecting the presence of termites, this device is expected to prove helpful in further studies of termites and other insects. In addition to the tom-tom beats, other insect sounds have been detected. One of these is a clicking sound which scientists claim is made by "sentry termites" snapping their jaws as they warn of danger. The insects seem to have a "grapevine" form of communication among themselves in which a signal made by one termite is repeated by another down the line.

Much of the technical construction work on the new detector was done by Stephen Craig (shown in the photo), who plans to manufacture units for use by termite inspectors. —30—

Electronic detector finds termites without need for ripping up floor.



Voice-operated Alarm

By NATHAN GREEN

THE NORMAL individual has no idea of the difficulties encountered by the handicapped person. Events and situations which are easily mastered become stumbling blocks to these unfortunates. The senses not only provide enjoyable sensations, but they also serve to warn of something being amiss or of impending danger. One of the most distressing things to the deaf mother is to be unable to hear the outcry of her baby. This article presents a device specifically designed for the use of such afflicted persons. It is arranged to light an alarm lamp when actuated by a sound; in this case it is intended to provide a warning of a baby crying.

The circuit diagram is shown in Fig. 4. The basic idea behind the design is to have the alarm as safe to use as possible. This is accomplished by: (1) employing in the power lead a fuse of the proper capacity; (2) using an isolated ground lead to avoid a "hot" chassis; (3) employing a low voltage for the alarm lamp; and (4) designing the circuit so that if any part fails to function the alarm will go on. In the interest of economy, a PM speaker is used as a microphone and a transformerless power supply is used to supply the "B" voltage. A 6.3-volt transformer is used for tube heaters and for low voltage power to the alarm circuit.

Output from the speaker feeds into the transformer *T2*, the secondary being paralleled by the sensitivity control which leads directly to the grid of *V1*, a 12AX7. The two halves of this tube are employed as a resistance-coupled high-gain amplifier, the output of which is applied to *V2*. The grid coupling capacitor is much smaller than normally employed in audio amplifiers to reduce the 60-cycle response which would otherwise be troublesome in such a high-gain amplifier. Tube *V2*, a 12AT7 with the two triodes connected in parallel, normally conducts with a plate current of about 7 ma. energizing the relay. When sufficient audio signal from *V1* is applied to the grid of *V2*, grid-leak bias is developed which cuts off the plate current and de-energizes the relay. The two triodes are used in parallel to provide more positive operation in the presence of contact potential grid bias. With the 2.2-meg. grid resistor, about 1 volt of negative grid bias is produced by the tube contact potential. With the available plate voltage, 1 volt of bias reduces the plate current too much for positive relay operation. By connecting the two triodes in parallel, the total relay current is twice the value of the plate cur-

Fig. 1. Over-all view of the complete alarm unit. The warning light is at left, the speaker microphone at right.

rent of one triode. The 47-ohm cathode resistor produces sufficient self-bias in addition to the contact-potential bias to provide the proper relay current and still allow plate current cutoff at low signal levels.

When the relay is de-energized, the alarm lamp will light and it will stay lit until the reset button is pushed. Pushing this button sends current through the relay coil, attracting the armature and thereby setting it up for the next actuation. One of the pilot lamps indicates when the power is turned on and the other indicates when the alarm lamp has been energized.

The power supply derives its "B+" voltage from the a.c. line. A selenium rectifier and a triple filter capacitor are employed together with resistors *R2* and *R4* to provide adequate filtering. The power switch is separate from the sensitivity control so that, once set, this control will not be disturbed when the unit is turned on and off.

Construction Details

The main unit is built in an aluminum box 9" x 6" x 5", containing a chassis 1½" deep. Figure 2 shows the parts layout

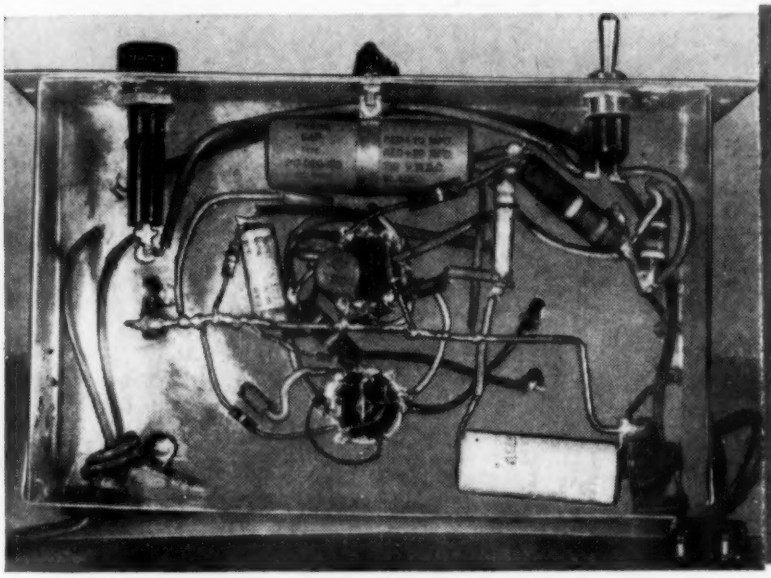


Fig. 2. This under-chassis view shows the placement of parts beneath the chassis. Note the solid copper bus used for the circuit ground. This bus is insulated from the chassis and is supported by terminal strips.

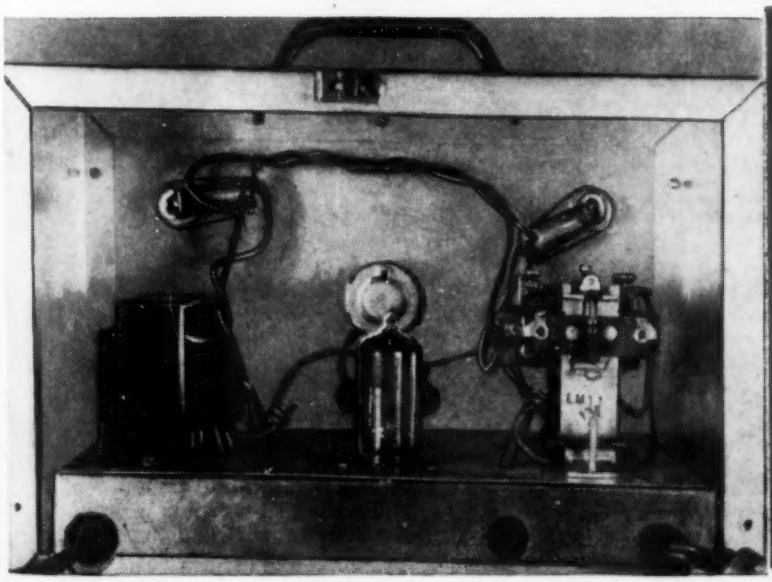
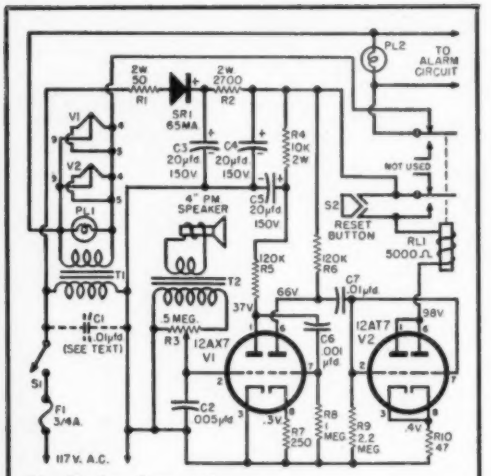


Fig. 3. Rear view with back cover removed. Location of filament transformer (T1) and relay (RL1) can be easily seen. The selenium rectifier (SR1) is mounted above the chassis directly behind T1. R3 can be seen above the tubes.



R1—50 ohm, 2 w. carbon res.
R2—2700 ohm, 2 w. carbon res.
R3—500 k pot, audio taper
R4—10 k, 2 w. res.
R5, R6—120 k, ½ w. res.
R7—250 ohm, ½ w. res.
R8—1 megohm, ½ w. res.
R9—2.2 megohm, ½ w. res.
C1, C7—.01 μfd., 400 v. paper capacitors
C2—.005 μfd. ceramic capacitor
C3, C4—20-20 μfd., 150 v. dual elec. capacitor
C5—20 μfd., 150 v. elec. capacitor
C6—.001 μfd., 400 v. paper capacitor
PL1, PL2—No. 47 pilot light bulb, socket, and jewel
F1—¾ amp. fuse and holder
T1—Filament transformer, 6.3 v. @ 3.0 a. (Merit P-2946 or equivalent)
T2—Output transformer (Stancor A4744 or equivalent)
S1—S.p.s.t. toggle switch
S2—S.p.s.t. normally open push-button switch
RL1—D.p.d.t. plate relay, 5000 ohm coil (Potter & Brumfield, LM11 or equivalent)
SR1—65 ma. selenium rectifier (Federal Type 1002 or equivalent)
1—Line cord
2—Octal tube sockets
1—12AT7 tube
1—12AX7 tube
2—Pin jacks for input from speaker
1—4" PM. speaker, 3.2 ohm voice coil
1—Aluminum box 9" x 6" x 5" with a chassis 1½" deep
Misc. machine screws, nuts, wire, solder, terminal strips, etc.
Total cost of parts, approx. $23.00

Fig. 4. Schematic diagram and parts list.

which was designed to permit the neatest wiring with the shortest connections. A stiff bus wire mounted on insulated terminal lugs serves as the common negative; it also supports the various components. The selenium rectifier was mounted above the chassis where it will run cooler and thereby provide greater reliability and longer life. Otherwise, the wiring is fairly straightforward, the shortest possible connections being used. Several ventilating holes are drilled in the back of the box.

It was found advantageous to have a separate box to house the "microphone" and its transformer, a shielded 5' cable being used to make the connection to the amplifier. The alarm lamp is at the end of a 20' piece of lamp cord which terminates in a plug near the relay. The builder will have considerable latitude in selecting any type of plug he wishes. The one employed here is the type used to connect trailer tail lights to the automobile electrical system; the alarm lamp is a standard automobile "back-up" light set into a small wooden base.

Liberal use was made of rubber grommets and insulating "spaghetti" where the wires must pass through holes in the chassis. The operating voltages indicated on the circuit diagram will help the builder in troubleshooting. All voltages are measured with a v.t.v.m., using the common negative as the reference point.

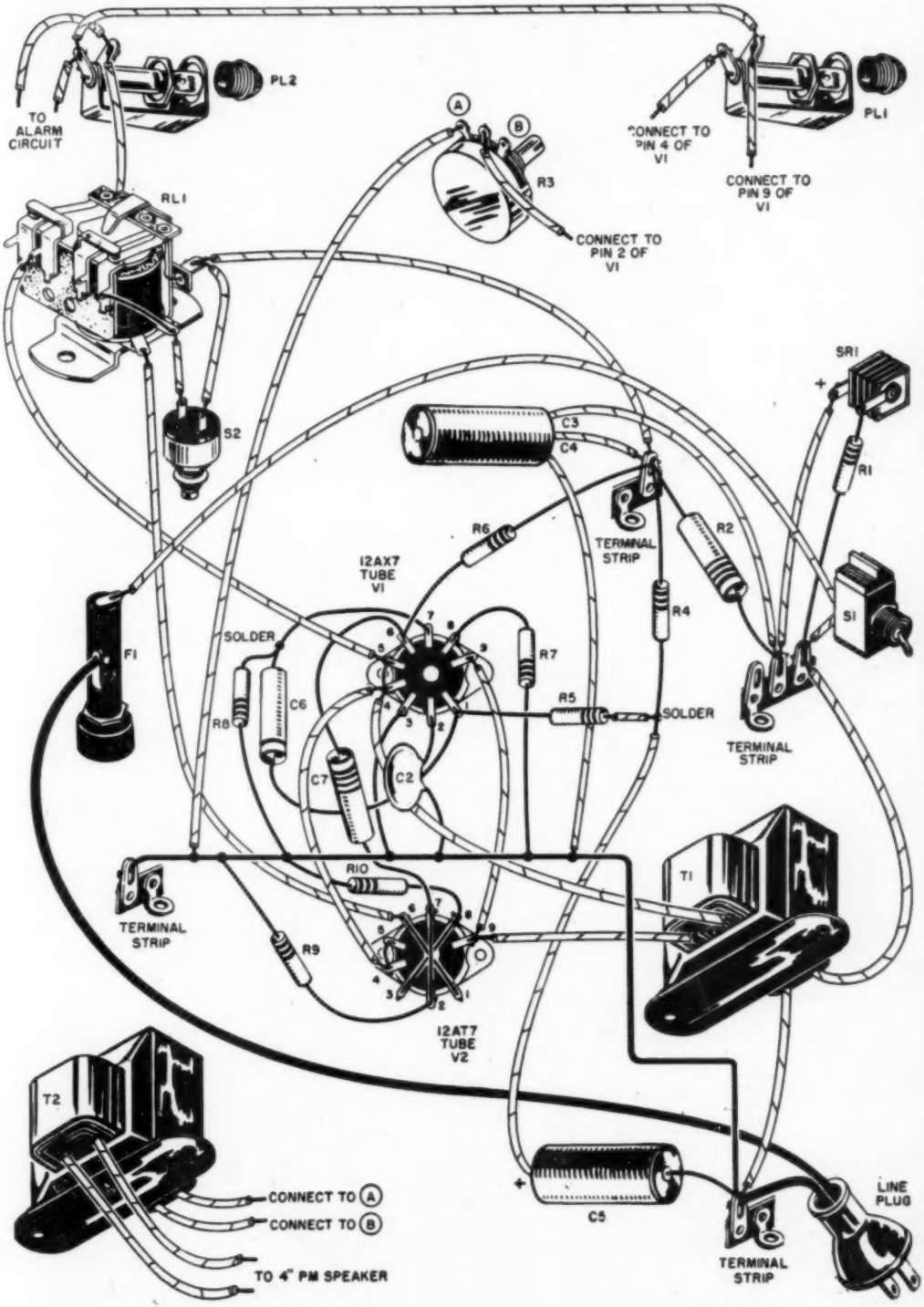
R.F. Pickup

Because of the high gain of the amplifier, a certain amount of trouble was encountered from r.f. pickup. There is a 50-kw. AM transmitter less than a mile away from our workshop and the signal is received with sufficient strength to make the operation very erratic. Several steps were taken to minimize this effect: (1) the "mike" cable is color-coded so that the shield is connected to the common negative bus: (2) the a.c. cord should be oriented so that the grounded pole of the line is connected to the common negative; (3) if necessary, the entire box may be connected to an external ground to reduce the pickup further; (4) the .005-μfd. capacitor tends to bypass any r.f. signals from the sensitivity control arm to ground, without unduly attenuating the audio signal; (5) under especially severe conditions it may be advisable to use a .01-μfd. capacitor in the primary of *T1* (*C1* in Fig. 4).

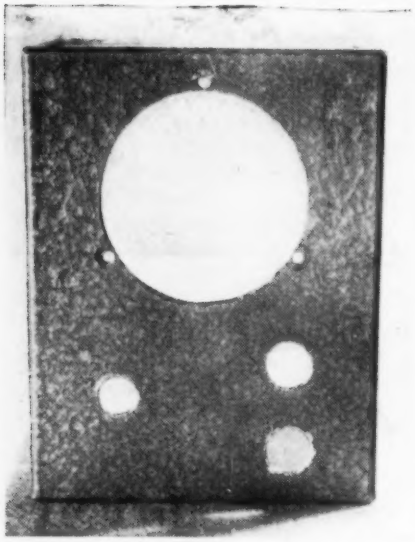
Operation

The amplifier unit will normally stand on a small table or dresser in the infant's room, while the microphone will be close to the bed or crib. In order to eliminate the effect of extraneous noises, the sensitivity control should be set at the lowest setting which will actuate the alarm with the baby crying softly or whimpering.

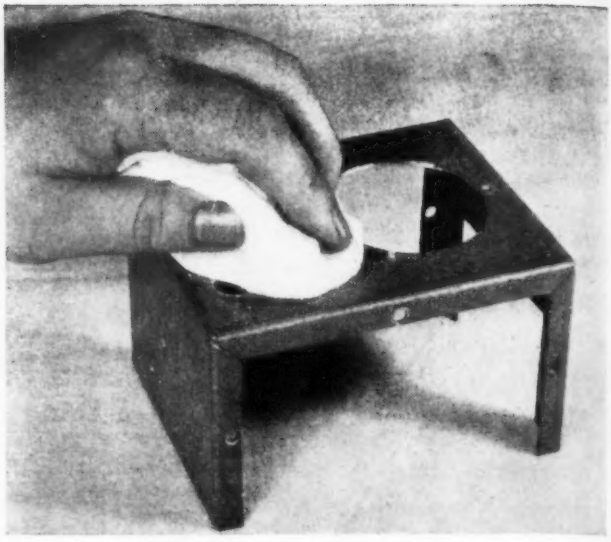
A number of other uses for this device will immediately become apparent. For instance, it can be arranged to detect operation of a door bell or door knocker. Another interesting possibility would be arranging the alarm circuit to energize a photographic flash bulb so that a picture would be taken when a sound actuates the device. —30—



Pictorial diagram of the alarm. It is important that the "B—" side of the line be grounded to avoid shock hazard at the microphone cable. A polarized plug, as described in the article entitled "Keep Dry with the Rain Alarm," which appeared in the June issue, will be of help in this respect. As an additional precaution, insulated shielded cable should be employed to connect the speaker microphone to the main chassis (shown as leads A and B above), and connections made inside the chassis rather than by means of pin jacks as shown in the photos.

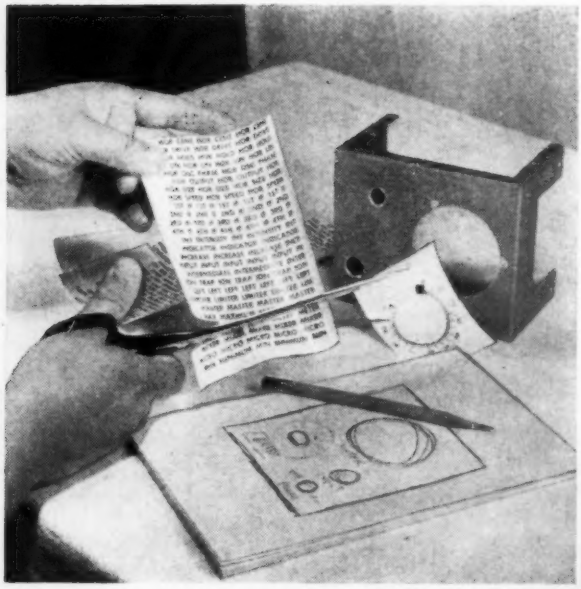


1 All machine work on the front panel, including drilling, etc., must be done before decals are applied.

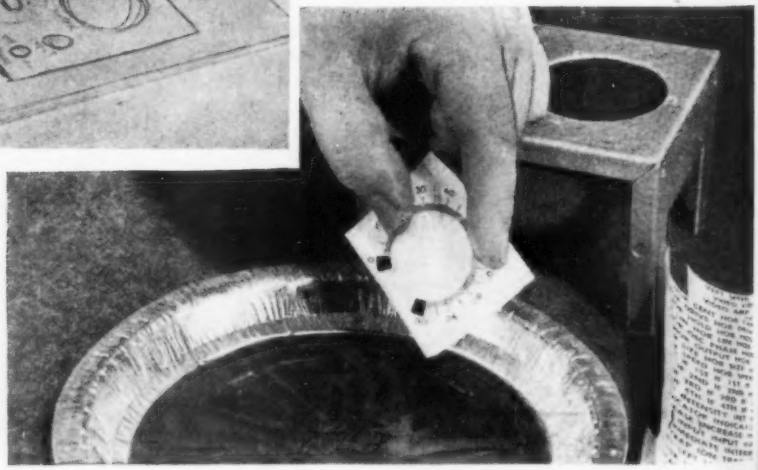


2 Using a soft cloth dampened with clean water, wash the front panel thoroughly. Be sure you remove all grease, finger marks, and dirt before applying decals.

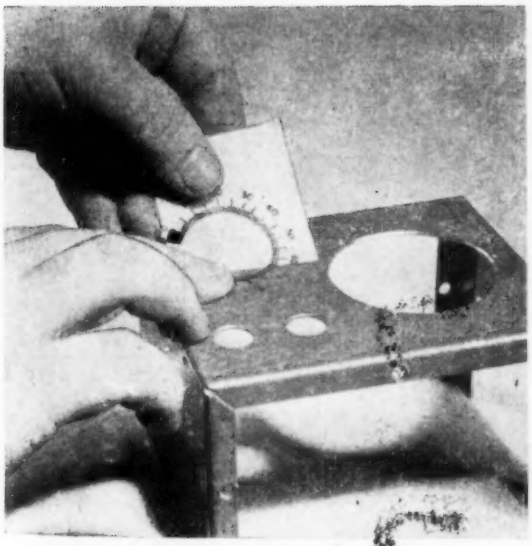
How To Use Decals



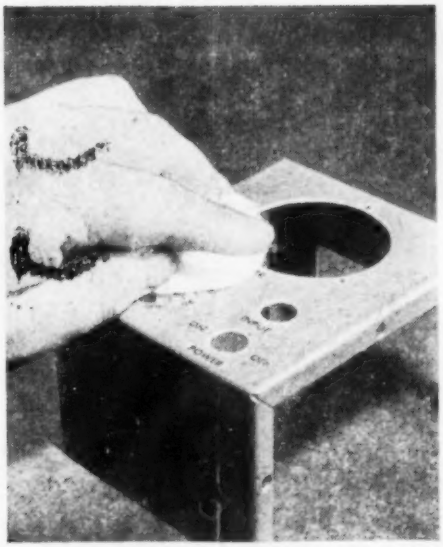
3 Make a penciled sketch of the equipment you want to label, identifying all controls. Then select and cut out decals.



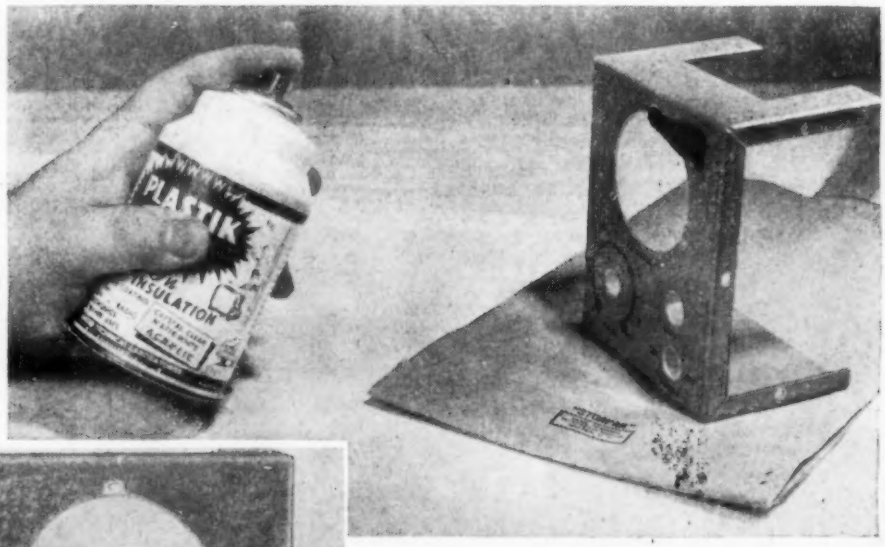
4 Dip decals in clean water. Do not let them soak. Simply wet them thoroughly, then set aside for a few seconds before use.



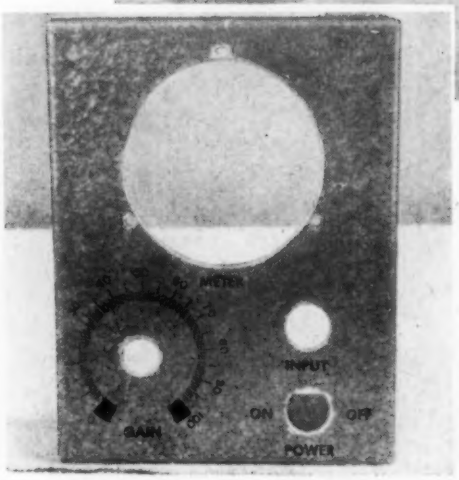
5 In a few seconds the decals will come loose from their backings. Moisten the equipment to be labeled, then slide decals into place.



6 Using a soft cloth, press decals firmly against panel and remove excess moisture. Be sure to remove all air bubbles.



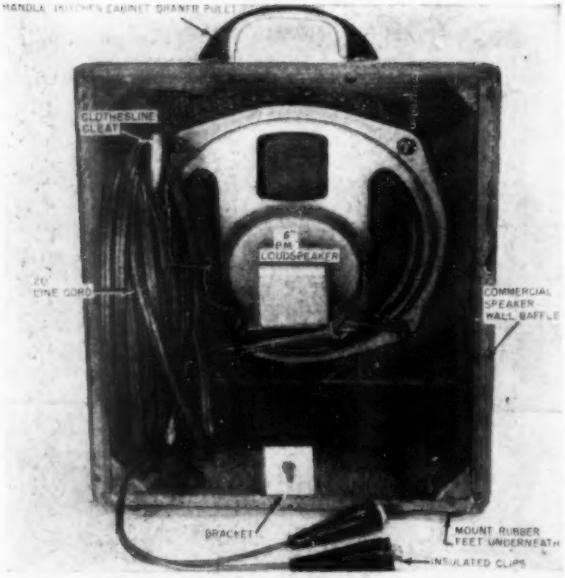
7 After all decals have been applied, set the panel aside until thoroughly dry. Next spray on two or three coats of transparent plastic, allowing the panel to dry between each coat.



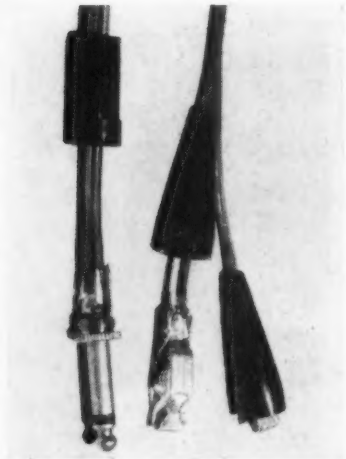
8 A completed front panel. After the plastic covering thoroughly hardens, mount controls and other parts. Compare with Fig. 1.

How To Add Extension Speakers

This baffle enclosure, mounted on a wall, provides housing for the general-purpose extension loudspeaker.



Rear view of the extension loudspeaker before baffle was mounted on wall. Terminal connectors may be clipped directly to radio speaker terminals.



Two types of speaker line cord terminations. Phone plug at left requires matching input receptacle. Clips at right are insulated for safe handling.

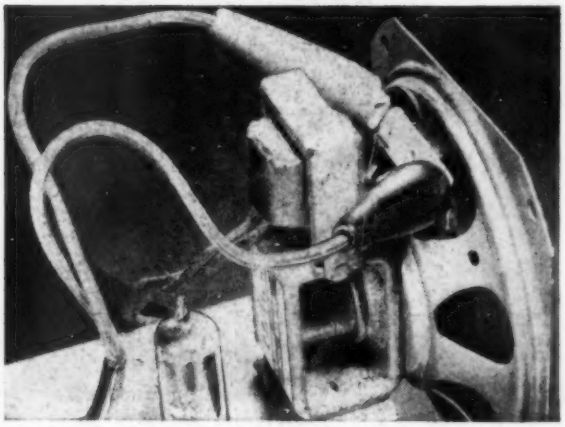


Photo at right shows line cord from remote loudspeaker connected to voice coil terminals of radio loudspeaker by means of insulated copper clips.

CARRYING a radio all over the house can be mighty annoying. But many of us like to listen to music and news wherever we are, whether in the workshop, laundry, or kitchen, and can't afford a radio in every room. An inexpensive and quite satisfactory solution is an extension loudspeaker. Costing considerably less than even a table model radio, an extension speaker may be added not only to radio receivers, but to TV sets or record players. You can even add one to an auto radio if you wish.

A general-purpose extension speaker is shown in the photographs. The components needed for building a duplicate unit are readily available. You can pick up the line cord (ordinary lamp cord will do fine), the clothesline cleat and the handle at a hardware or dime store.

Although parts cost is not high, if you want to "shave corners" and assemble a less expensive unit, you can eliminate all "frills"—the handle, clothesline cleat, insulated clips and rubber feet. A small loudspeaker may be used instead of the 6", 6-8 ohm job discussed here, and a home-made rather than a commercial baffle employed. If you use a 5" speaker, you'll find that a wooden cigar box may be refinished to make an attractive speaker baffle.

The mounting bracket is designed so that the baffle may be held securely on a wall by a single screw yet removed easily whenever desired. It is made up from a small piece of $\frac{1}{16}$"-thick sheet metal stock.

To assemble the unit, first locate the four speaker mounting holes by holding the speaker against the baffle. Drill these holes carefully to avoid scratching the finish. Mount the speaker using four ornamental head machine screws, lock washers and hex nuts.

Separate one end of the lamp cord for about 6", strip the insulation, and solder the two ends to the voice coil terminals on the speaker. The other end of the lamp cord may be terminated in one of several ways, depending on how you plan to install the speaker.

Installing Extension Speakers. For a temporary installation, set the extension speaker on a table or on the floor, run the line cord to the receiver or record player to which you wish to connect the extension speaker, and clip the leads directly to the voice coil terminals.

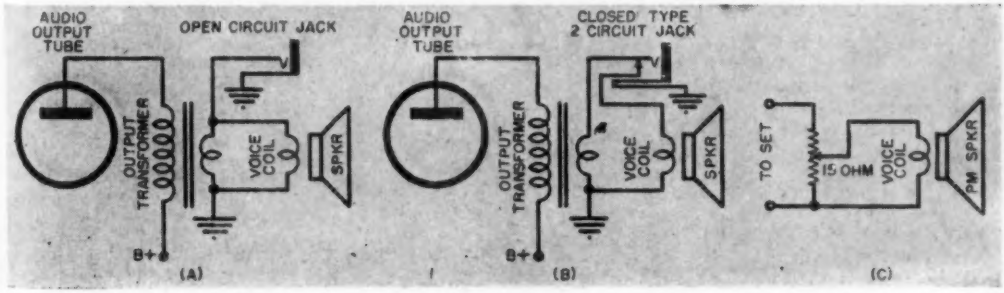
A similar procedure may be followed for a permanent installation, except that greater pains are taken. Mount the extension speaker permanently in place on the wall. Run the line cord to the receiver in a neat manner, fastening it in place along the baseboard. Use insulated staples. *Solder* the extension speaker leads to the voice coil terminal lugs in the receiver.

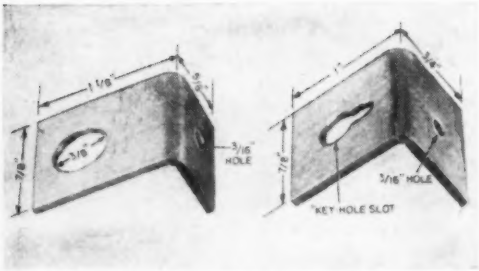
Although the "temporary" and "permanent" installations described are quite satisfactory within their limitations, you may prefer a "semi-permanent" installation. In this type of installation, the extension speaker is generally left in one location and connected to one receiver, but may be easily moved to another location or connected to another set. For example, you might want to leave an extension speaker in the kitchen during the winter, and then move it out to the patio or yard during the summer.

For this type of installation, the speaker may still be mounted on a wall and the line cord run neatly in place along a baseboard. Instead of soldering the speaker leads in place or using temporary clips, fit a phone plug on the end of the speaker line. Install a phone jack on the receiver to which you wish to connect the extension speaker.

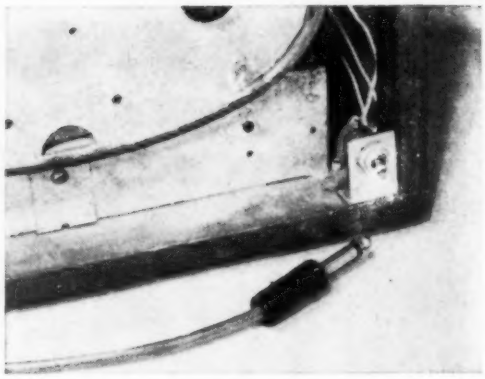
Either an "open-circuit jack" or a "closed-circuit jack" may be used, depending on whether you wish the extension speaker and the receiver speaker to operate simultaneously or individually. If an open-circuit jack is used, the two speakers will operate simultaneously, even when the ex-

Useful circuits for installing extension speakers. Details are given in text.





Left, a "jack bracket"; right, speaker mounting bracket. Both are easily made.



A typical "closed-circuit jack" installation. Note the use of the "jack bracket."

tension speaker is plugged in (although some readjustment of the volume control may be necessary to bring the volume to the desired level). This is the type of operation obtained with the "temporary" and "permanent" installations described. The connections to use for an open-circuit jack are shown in the diagram (A).

On the other hand, if you want the extension speaker to "cut out" the receiver speaker automatically, so that only the extension speaker operates, use a closed-type, 2-circuit jack, installing it as shown in the diagram (B).

Volume Controls: In most cases, it is not necessary to provide an individual volume control for the extension speaker. The volume control in the receiver is used to set the level. There are a few installations where a volume control may be desirable, however. An example would be an extension speaker installed in a sick person's room.

The simplest type of loudspeaker volume control is an inexpensive wirewound potentiometer, connected as shown in the diagram (C). Use a 15-ohm, 3-watt wirewound unit. With this type of control, the volume of the main speaker in the receiver may change slightly as the sound level at the extension speaker is adjusted.

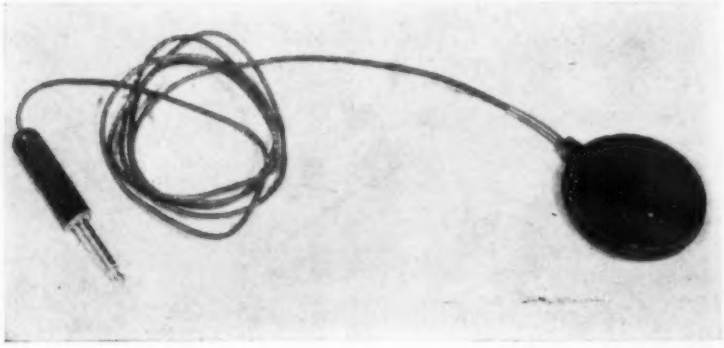
For more critical installations, use an especially designed loudspeaker volume control. Typical units are the *Mallory* Type T8, L8, and TSA-10 controls. Follow the manufacturer's instructions when installing special controls.

Special Installations: One popular type of "special" installation is a "pillow" speaker. These speakers slip inside a pillow case and permit the user to listen to radio programs late at night without disturbing the rest of the household. Obtain a low-impedance pillow speaker (such as the *Telex* Type 8110), and install it in the same way you install a regular extension speaker. For best results, use a "closed type, 2-circuit jack" installation, following the circuit given in diagram (B).

In recent years, the popularity of "rear seat" extension speakers on auto radios has been increasing. Such speakers permit a more even distribution of sound.

The installation of an extension speaker in an auto is essentially like that of one in the home, except that a different baffle arrangement is employed. The extension speaker is generally mounted on the shelf behind the rear seat.

Several manufacturers offer complete "kits" for the installation of rear seat auto speakers. Such kits include the speaker, baffle, line cord and, sometimes, a simple switch. A typical kit is the *Quam* Model AS-3. —30—



This unique speaker is designed to slip into a pillow case and permit the user to listen to late programs without disturbing anyone else.

R/C NOTES

THE BIG NEWS in R/C flying in July is the 1955 Nationals, to be held at *Los Alamitos Naval Air Station* outside of Long Beach, Calif. The dates are from July 18 through 24. To be eligible for competition in the National Championship Model Airplane Contest, you must have a model flyer's license issued by the Academy of Model Aeronautics.

This year, the event is being entirely sponsored by the Academy with the cooperation of the United States Navy, which is acting as host. An excellent guide to the Nationals for both contestants and observers is the "Official Model Aircraft Regulations for 1955-1956," just issued by the Academy. We suggest that you write to the Academy at 1025 Connecticut Ave., Washington 6, D. C., for further information on the contest and to obtain a copy of the "Regulations."

ALL OF THE R/C EQUIPMENT included in the build-it-yourself articles in recent issues of POPULAR ELECTRONICS has been crystal-controlled for use on 27.255 mc. The reason we have emphasized the use of this frequency when, actually, there are three other bands also available in the Citizen's service, is that we feel equipment required for 27.255-mc. operation is less complex, more stable, less expensive, and in general, more suitable for our readers than equipment that would be required for the other frequencies.

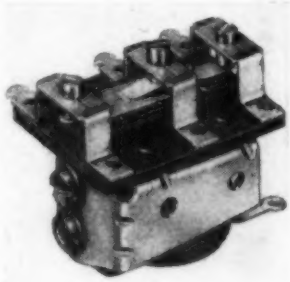
Also, in contrast to using regular radio amateur bands, no operator's license is required for operation on 27.255 mc.; only the equipment must be licensed. The latter consists merely of filing a form 505 with the FCC and noting therein that the equipment used is crystal-controlled. (However, the operator must be 18 years old or over, and a citizen of the U. S.)

As any of you who have flown R/C model airplanes are aware, the 27.255-mc. band is relatively crowded, especially at contests. We've also had letters from readers who want to build radio-controlled garage door openers but don't want their equipment to interfere with their neighbors', as would be the case if 27.255 mc. were used.

The solution to these problems is relatively simple. Use the other Citizen's bands! These other bands are open for radio control, telegraphy, voice communication and, in fact, anything that is not covered under the other existing frequency allocations—provided you get an equipment license from the FCC. (For telegraphy, an operator's license is also required.)

These other bands run from 460 to 468 mc. As you can see, the frequency of operation is in the u.h.f. spectrum and special construction techniques are required. However, if you think you would like to try some equipment in this range, let us know and we'll be happy to publish some stuff for you. One definite advantage of operating on these frequencies is that you can use more power (10 watts vs. 5 watts on 27.255 mc.).

AN UNUSUALLY SMALL SENSITIVE RELAY designed for use in R/C boats, aircraft, cars, etc., has just been marketed by the *Advance Electric and Relay Co.* of Burbank, Cal. The new relay, the "SO," occupies only 1⅛" x 17/32" x 1¼" space and weighs only 1½ ounces. It normally operates on about 10 milliwatts of power but can be adjusted to use about 2 milliwatts.



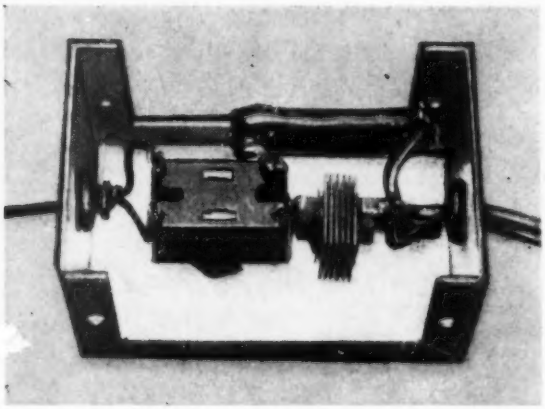
This relay can withstand up to 10 *G* shock and up to 20 *G* vibration. It can be furnished with any one of three coil resistances: 4000, 6500, or 10,000 ohms.

WE'VE JUST RECEIVED a very interesting letter from Mr. Phillip H. Jensen, who is vice-president of the *International Association of Automotive Modelers*, an organization concerned with promoting the construction of scale display model autos, both foreign and classic. Since every radio-controlled model auto must have a chassis and body, he points out, why not use a scale model? This organization can supply plans of many foreign sports cars and will soon have a number of classic car plans available for any R/C fans who are interested.

The *Association* will welcome R/C auto modelers into the club, provided that the models involved are sports, classic, antique, or racing types built to scale.

Anyone wishing to practice two very interesting hobbies at the same time can contact Mr. Jensen at Skyview Drive, R. D. 1, Cohoes, New York, for more information. —30—

Rejuvenate R/C BATTERIES



Subchassis view of the complete rejuvenator.

By PAUL F. RUNGE

Don't waste money by discarding batteries which test low; this rejuvenator extends their life.

IT IS a safe bet that quite a number of R/C batteries are discarded as worn out long before their active life is really over. This procedure is not only expensive but also entirely unnecessary when the simple process of rejuvenation is used.

Rejuvenating a dry cell is entirely possible, theoretically and practically. Many of the larger electronic manufacturers have published plans for rejuvenators in some of their books and pamphlets.

In practice, as a dry cell is used, the carbon electrode gathers hydrogen. If the drain is fairly high, hydrogen gathers faster than the battery can dissipate it during the "off" periods. Consequently, when it is used again, only a little of the hydrogen has been removed. Continued operation adds more hydrogen, with the result that the battery becomes useless long before the chemical agents in it have been fully used.

Ideal operation of dry cells calls for intermittent use spaced out over a period of time. In this way, the zinc container will be well used up when the battery shows signs of wearing out. In radio control, batteries are employed fairly frequently and the drain is high, so that the zinc is barely touched and the chemicals only slightly used. However, the hydrogen keeps the battery from functioning the way it should.

To rejuvenate a battery, the carbon electrode should be depolarized. This depolarization assists the battery chemicals in removing the hydrogen after each use.

Tests indicate that R/C batteries—from the smallest pen cell to the 67½-volt transmitter "B's"—when rejuvenated after each use, will last two to four times as long as when they are not. Under average conditions, the active R/C'er will save the cost of a rejuvenator in less than a season.

Because R/C batteries are generally small in size, the design of the rejuvenator can be considerably simplified. The charger to be described uses the battery itself as a capacitor, and thus will automatically adjust its voltage and current to the size of the battery being charged. The design also allows for complete enclosure, minimizing shock danger. Construction is very simple, since a minimum of parts is used.

Begin by drilling the three holes required in the *Bud* "Minibox." Install grommets in the a.c. cord and battery-lead holes, and mount the switch with its "on-off" plate onto the cover.

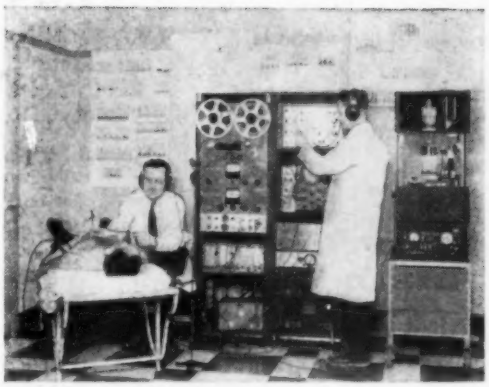
Insert the a.c. cord and tie a knot on the inside so that it cannot be accidentally jerked back through the grommet. Solder the two leads to two poles on the double-pole, single-throw toggle switch. Such a toggle switch is used so that, when the charger is turned off, the circuit will be

(*Continued on page* 107)

"Photographing" the Heart Beat

A NEW TECHNIQUE for illustrating visually the sound of the human heart has been developed during the past year at the Johns Hopkins University Department of Medicine in Baltimore, Md. Called "spectral phonocardiography," the process results in pictorial photographic records of the heart sounds. Currently being used as an aid in teaching medical students, it also has a growing application as a diagnostic tool.

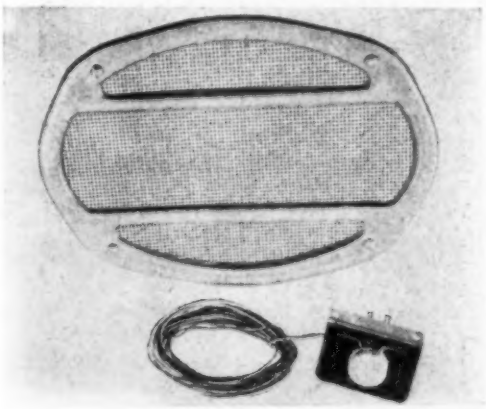
Spectral phonocardiography resulted from a research project headed by cardiologist Dr. Victor A. McKusick and electronic engineer George N. Webb. It is related to the idea of "visible speech" which originated at the *Bell Telephone Laboratories*.



The process involves the use of a special capacitor microphone, magnetic tape recorder, a vibration analyzer, and other electronic instruments. —30—

Kit Mounts Rear Seat Auto Speaker

A REAR SEAT SPEAKER GRILLE KIT for car radios is the latest addition to the *Walsco* line of radio-TV products. Easily installed in all makes of automobiles, the new kit is available in two sizes—for a 5" x 7" speak- and for a 6" x 9" speaker. Both the baffle plate and metal grille screen are finished in gray hammertone.



Included in each kit are the baffle plate with screening, 15 feet of cable, all necessary hardware, a crossover switch for selecting front, rear, or both speakers, and complete instructions. List prices are $3.75 for the smaller kit, and $4.50 for the large size. Jobbers and dealers can also purchase the grille alone from *Walsco* without the switch and cable.

For more information on this auto accessory, write to *Walsco Electronics Corporation*, 3225 Exposition Pl., Los Angeles 18, Calif. —30—

Electronic Tests to Improve Beef

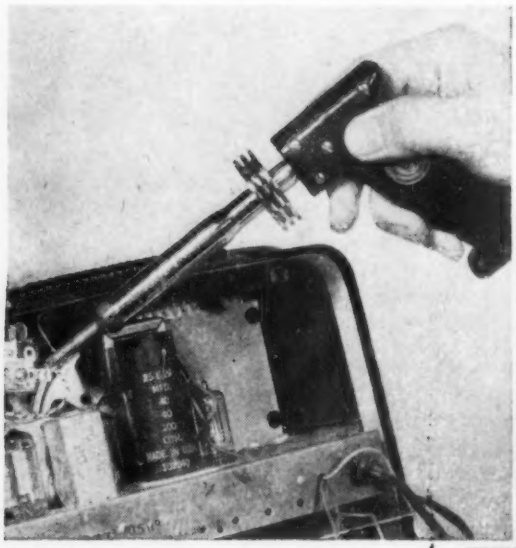
BETTER BEEF FOR BRITONS is the aim of a new electronic harness being worn by a test group of cattle. This device registers how many times a day the grazing animal stretches its neck to chew grass, how often it lies down and stands up, and even the number of times it twitches its tail. Every movement is recorded by the equipment as a series of wavy lines on a constantly moving paper tape.

Tests made with this harness are helping scientists learn which grasses cattle like best and which are most effective in helping the animal to gain weight. The number of mouthfuls of grass eaten to add a pound of beef is accurately determined. Better milk production is also expected as a result. The equipment was made by *Burgess Products Co., Ltd.*, Gateshead, England. —30—

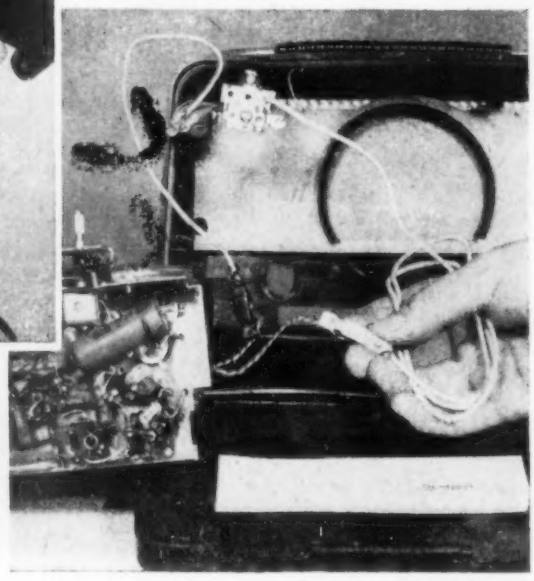
MINOR defects, amendable by the owner, often occur in small radios. The faults and correction techniques illustrated in the photographs on these pages can usually be handled by someone with some electronic knowledge. The radio used as the "guinea pig" is a *Sentinel* Model 335P a.c.-d.c.-battery portable with a 4½-volt "A" battery and 90-volt "B" battery, drawing 35 watts on a.c.

If the radio operates on a.c., but not on batteries, measurement of battery voltage is in order. A 90-volt battery should measure at least 85 volts with the set in operation.

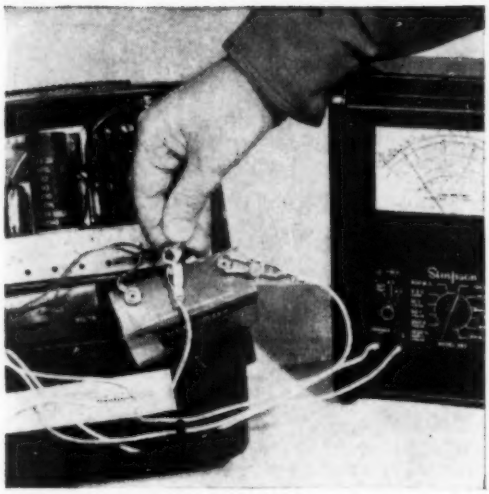
How to Keep Your



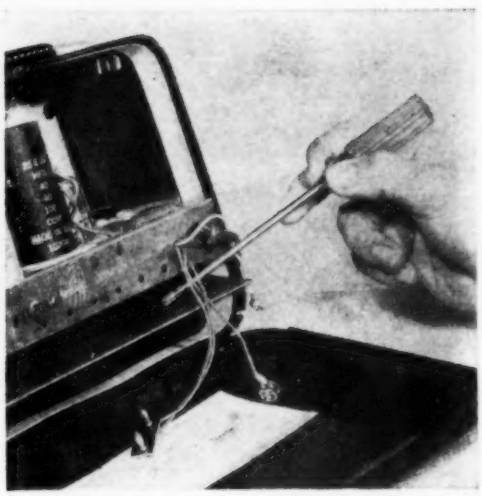
← If components fastened to the cabinet prevent the chassis from being taken out, they must be removed. If unsoldering is necessary, perform the operation very carefully to avoid damaging components. Here two wires are unsoldered from an adjustable capacitor across a built-in loop antenna.



After chassis has been removed from the cabinet, use a pair of flexible wire leads to connect the radio lead-in wires temporarily to built-in loop antenna. The chassis may be "hot" to ground, depending upon power plug polarity. Before attempting any repairs, check for presence of a.c. voltage between chassis and ground. If any voltage is detected, reverse the power plug.

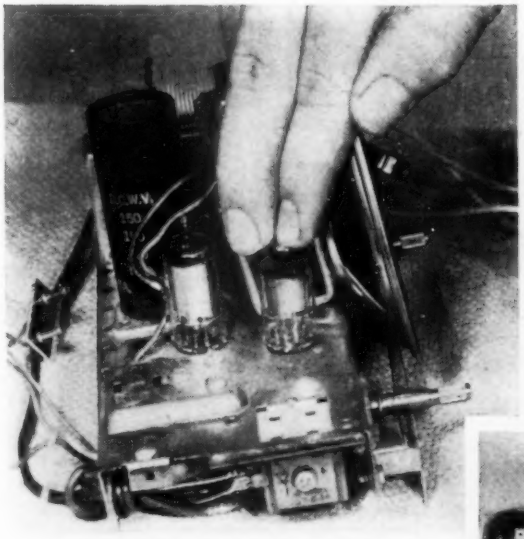


Connect a milliammeter in series with one "B" battery lead. Compare reading with service data or normal reading on same receiver. Excessive current may indicate a short circuit.



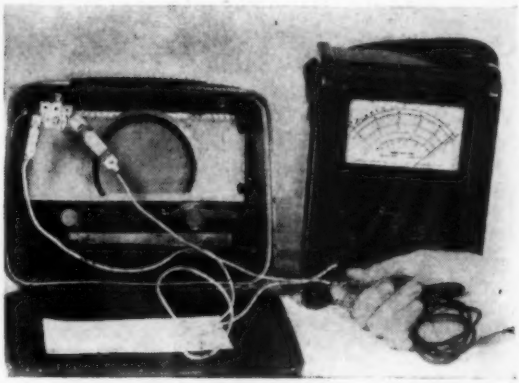
Trouble not caused by batteries may require chassis removal. A Phillips-type screwdriver may be required to loosen the screws holding the chassis in place in the cabinet.

Portable in Operation



Other parts, such as capacitors and resistors, may be roughly checked with an ohmmeter by disconnecting one terminal. Try a few new components to learn about what to expect of good equipment so that you can recognize a faulty component when it turns up in your portable. –30–

← With the radio turned on, gently push each tube down to be sure they are all properly seated. If none of the tubes are lighted, any one may have an open filament. Remove power and check filament of each tube with an ohmmeter. If the radio operates on batteries, but not on a.c., the selenium rectifier (right) may be at fault.



The loop antenna may be checked → with an ohmmeter set on a very low scale. A reading of one ohm or less indicates that antenna is O.K. One wire should be disconnected from the capacitor for this check. The capacitor itself may be checked with the ohmmeter set on a very high scale. A reading of infinity will indicate that the antenna capacitor is normal.

Tuning the Short-Wave Bands

By HANK BENNETT

SEVERAL TIMES in the past, readers have asked where they could obtain a good map of the world that would be useful as well as ornamental. I believe that I have located a good one showing the world centered on New York City. This Great Circle Chart, an extremely accurate chart of the world, is constructed on the "Azimuthal Equidistant Projection," and shows the shortest distances and Great Circle directions from New York City to all places in the world. Distances are available in statute and nautical miles and kilometers.

This chart has already proved of great value to aviation, professional and amateur radio operators, newspapers, shipping, schools, and also for geographical work—especially in connection with the new concept of global geography which includes consideration of the polar regions.

The chart circle, 35" in diameter, is printed on a sheet 43" x 36". The center of the circle, and also the circle of the world, is in New York City, a few blocks south of the 33rd Street Pennsylvania Railroad station (longitude 74° west and latitude 40°, 45 minutes north). Each degree from 0° (north) to 360° is marked on the circumference. All straight lines drawn through the New York center are Great Circles on the earth's surface. Latitude and longitude lines are spaced at 5° intervals.

A straight line drawn from New York to any other place on the globe indicates the shortest route to that place, and other places along the route are seen at a glance. This line extended to the circumference gives the degrees of azimuth or original Great Circle course; this is also the direction for pointing radio aerials. ("Azimuth" is reckoned in degrees, clockwise, east of north. Thus, east is 90° azimuth and west is 270° azimuth.)

Chart No. 3042 may be obtained from the Washington and New York offices of the U. S. Coast and Geodetic Survey, or from its authorized chart agencies, for 40 cents.

A READER HAS SENT US a copy of a letter from Radio Station HCJB, Quito, Ecuador. This is one of the easier short-wave stations to hear, especially on 11.915 mc. The letter, which reads as follows, is signed by D. S. Clark, Field Director.

"The Technical and Program Departments appreciate very much your recent letter reporting on the reception of our programs in your area. Since we are now in the process of building and installing new equipment as well as improving some of the old transmitters and antennas, we are naturally interested in knowing just how well our signals are reaching various parts of the world.

"For some time now, our short-wave broadcasts have been going out from Pifo, a small town about 12 miles east of Quito. Here are located five of our present six transmitters with their associated equipment. A piece of land, consisting of some 50 acres, is ample for our transmitting building, our diesel building which houses a diesel power plant capable of supplying some 400 kw. of electrical power, and high gain antennas, as well as homes for both foreign and national staff. The short-wave antennas consist of two sets of "curtains." One set is bi-directional for North and South America; the other is uni-directional for either Europe or the South Pacific. There is also a 275' tower which serves as antenna for our local long-wave transmitter.

"Our present equipment consists of one 10-kw. and four 1-kw. transmitters in Pifo and one 500-watt transmitter in Quito. The 10-kw. transmitter operates on both 17.890

One of P.E.'s New England reporters, John Flanagan, hails from West Newton, Mass. His DX'ing is done with a Hallicrafters SX-42 and a long wire antenna.

mc. in the 16-meter band and 11.915 mc. in the 25-meter band. There is a 1-kw. transmitter on each of the following frequencies: 15.115 mc. in the 19-meter band, 9.745 mc. in the 31-meter band, 6.050 mc. in the 49-meter band and 700 kc. long-wave for local reception in Quito.

"Our studios are located in Quito; we now have four studios and three control rooms. The programs are relayed to Pifo by a high-frequency FM link. Three FM transmitters provide for a total of three simultaneous programs as well as telephone communication between studio and transmitter personnel. During a large portion of the day, two different programs are broadcast simultaneously.

"We trust that reception in your area will be such that you will want to be a regular listener to HCJB. Sunspot activity is now on the increase, which promises improved short-wave reception in the next few years."

NOW FOR THIS MONTH'S listings. All times are based on Eastern Standard Time, 24-hour clock system.

BURMA—The *Burma Broadcasting Service* will probably have its four new *RCA* 50-kw. short-wave transmitters in test use soon after February 1, 1956. There will be an automatic antenna switching system which can switch any of the four international broadcasting transmitters to any of the 17 antennas (six of which are rhombics) within 15 seconds. Broadcasts can be made in four different languages simultaneously to four different target areas. (*Scheiner, N. J.*)

CANAL ZONE—A widely reported station located at Fort Clayton and operated by the U. S. Army as the Caribbean Forces Network is being heard occasionally on 7625 kc., parallel to ACA (790 kc.) and ACB20 (1420 kc.). The short-wave outlet is not always used but has been noted late evenings with ball games relayed to Puerto Rico as well as some Armed Forces Radio and TV Service programs.

COSTA RICA—TIHBG, 6015 kc., *Radio Cristal,* San Jose, is being heard on 6015 kc. although announcements give channel as 6006. (*Legge, Va.*)

DOMINICAN REPUBLIC—HI8Z, Santiago, has moved to 6076 from 5023 kc., and is being heard at 1900-2200. HI1N, *La Voz de la Reelection,* formerly located at Ciudad Trujillo, is now in Santiago, and can be heard at 1900-2300. (*Legge, Va.*)

EGYPT—Cairo, 17725, is used for the 0630-0930 transmission for South Asia, replacing 15315. The 11674 channel operates at 2330-0130 to Latin America, replacing 12032 kc. The 11670 Cairo channel is no longer heard with 0945-1700 Arabic transmissions.

Radio Prague, Czechoslovakia, sends a card showing a glossy photograph of the City of Prague to everyone who turns in a report of reception. The schedule to North America appears on the reverse side of the card.

ENGLAND—Some new frequencies of the *BBC* are: 6080 kc. (MCV), 6140 (MCW), 21660 (MCX), and 21740 (MCY). The following frequencies of the *BBC* have now been allotted call signs: 3952.5 kc. (MCM), 5975 (MCP), and 5990 (MCU). The program in French at 0645-0700 in the far eastern service has been discontinued and replaced by Vietnamese. (*World Radio Handbook*)

FRENCH GUIANA—In response to letters, the address of Cayenne on 6200 kc. is *Radiodiffusion Francaise de Cayenne,* Cayenne, French Guiana. Address your reports in care of A. LePrado, Le Chef de Centre de la *Radiodiffusion Francaise de Cayenne.* (*Hart, N. J.*)

GREENLAND—Station KOLD, "The Voice of Information Services for Thule Air Base," Thule, does not operate on 4425 kc. as previously reported, but on 1425 kc. with 1 kw. in English at 0600-0000 daily. (*Scheiner, N. J.*)

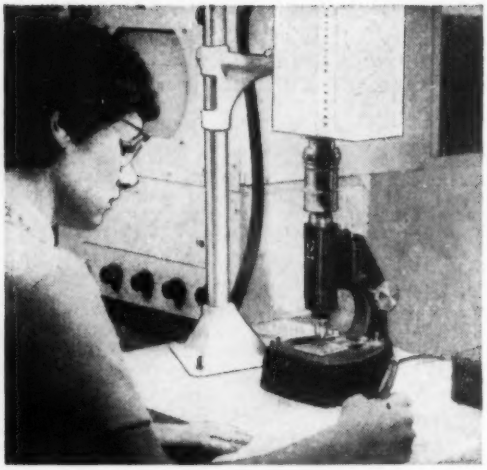
GUATEMALA—TGCQ, *Radio Central,* Guatemala City, formerly on 9700 kc., is now being heard at 1900-0000 on 6412 kc. TGNA, on 11850 kc., is still being heard well at 2200-2330. (*Legge, Va.*)

HONDURAS—Latest changes include HRN, Tegucigalpa, moving to 5873 from 5885 kc., and heard at 1900-2200. HRP1, San Pedro Sula, has moved from 6360 kc. to 5995 kc. and is heard at 1900-2200.

ITALY—A new channel for Rome is 6060 kc., replacing 6010 kc. Schedule runs from 2000 to 2210. English news and talks noted at 2120-2140 in North American service, parallel to 9570 kc. (*Wilson, Del.*)

LIBERIA—ELWA, Monrovia, on 11798, is a new station testing from 1115 to 1330 with religious programs, mainly in English. Best heard in the USA at 1230-1330 with *BBC;* 11800 kc. is off the air. (*Buettner, Germany; Legge, Va.*)

(*Continued on page* 96)



Extending Microscope Vision

A CLOSED CIRCUIT TELEVISION camera may be mounted vertically to extend the vision of a laboratory microscope by means of a new stand produced at *Kay Lab,* 5725 Kearny Villa Rd., San Diego, Calif. This application, important in education and industry, permits a microscope image to be presented on a large TV screen, and enables large numbers of observers to study with comparative ease the object beneath the microscope lens. Any number of remote viewing monitors can be connected to the system. Monitor screens can be located thousands of feet from the camera.

Similar mounting stands adapt the television camera to telescopes, transits, and periscopes. —30—

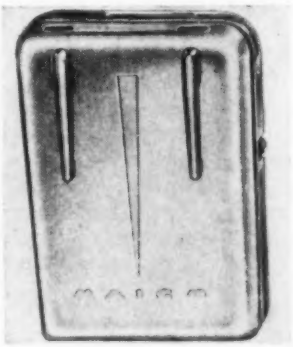
Versatile Code Oscillator

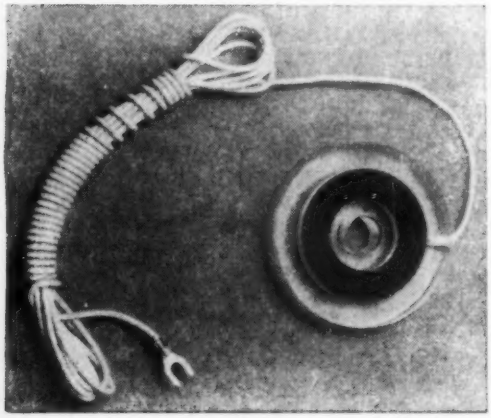
AVAILABLE AS A BUILD-IT-YOURSELF KIT is *Ameco's* new code practice oscillator. This unit will operate on 110 volts a.c. or d.c. and has a built-in 4" speaker. Other features include a filter to remove key-click noises; variable tone and volume controls; and provisions for several headphones or keys. After the code has been learned, the oscillator may be converted to a c.w. monitor.

The kit, with instructions but less tubes, sells for $11.75, net. For more information, write to *American Electronics Co.,* 1203 Bryant Ave., New York 59, N. Y. —30—

Hearing Aid Uses Five Transistors

FIRST ON THE MARKET to use five transistors, the new hearing aid introduced by the *Maico Company,* Minneapolis, Minn., reverses the trend toward small size and concealment in hearing aids. It weighs about six ounces and is several times larger than the smallest *Maico* models available. Size of the aid, according to the manufacturer, is of minor importance to those whose hearing loss is profound and who will gladly wear a larger, more powerful aid in order to hear again. Called the "Monarch 5," it features a top-mounted microphone. —30—





Novel TV Antenna

IN THE FORM OF a small plastic disc (vest-pocket size), the new "Clear-Vue" TV antenna is said to serve as a substitute for the bulky rabbit ears or outdoor antenna. It is small enough to be hidden from view, easily installed in a few seconds, and is recommended for the family which cannot have a roof antenna or which needs an extra antenna for the second TV set in the house.

Available in two sizes, the new device is priced at $1.00 for the "Junior" and $2.00 for the "Senior." It is presently sold by mail order from *G. Dalamango,* 160-26 26th Ave., Flushing 58, N. Y. —30—

AMA-TOURING with Roger Legge

WHEN listening on the amateur bands, you have undoubtedly noticed the great variation in reception conditions from day to day, with stations from distant areas coming in well on some days, but only stations from nearby countries being audible on other days.

This day-to-day variation in reception is due to changes in the ionosphere, the area 30 to 250 miles above the earth, in which ultraviolet radiation from the sun causes gases to break up into little particles of charged electricity called ions. Ionization causes radio waves to be reflected back to the earth at varying distances from the transmitter, but if the density of the ionized layer is too low, a radio wave of a particular frequency will penetrate through the layer and not be reflected back to the earth.

The condition of the ionosphere is constantly changing, as a result of variation in the amount of ultraviolet radiation from the sun. There are particularly extensive disturbances in the ionosphere when there are sunspots on the side of the sun facing toward the earth. During such severe disturbances, which may last for several days or more, reception on the high frequency bands—including the 14-mc. band—is usually poor.

It is therefore desirable to observe the general transmission conditions by tuning across the band and noting the areas from which stations are coming through, or tuning across the U. S. phone portion of the band and noting what stations are being called or contacted by the USA stations.

Notice of ionospheric conditions is transmitted by National Bureau of Standards radio station WWV at 19 and 49 minutes past each hour on 2.5, 5, 10, 15, 20 and 25 mc. WWV indicates propagation conditions by transmitting (in c.w.) N for normal, U for unsettled, or W for warning of a disturbance in progress or expected during the next several hours. The letter is followed by a number indicating forecast of conditions on North Atlantic paths, using numbers between 1 (useless) and 9 (excellent).

European Amateurs

Reception of European amateurs is much more dependent on favorable ionospheric

JULY DX FORECAST FOR 14-MC. BAND

From	In Eastern & Central USA (EST)	In Western USA (PST)
West Indies, Central America, Northern South America	0600-2300 Best 1700-2200	0600-2200
Southern South America	1600-2300	1600-2100
Europe and North Africa	0600-0900 1400-2000	1300-1700
Central and South Africa	1500-2000	1400-1800
Near and Middle East	0600-0700 1500-1900	1400-1700
Far East	0630-0830	1800-0100
Australia and New Zealand	0700-0900	1900-2300

In these forecasts, based on information obtained from the National Bureau of Standards, the 24-hour clock system has been used. The hours from midnight until noon are shown as 0000 to 1200, while the hours from 1 p.m. to midnight are shown as 1300 to 2400. EST represents Eastern Standard Time; PST is Pacific Standard Time, three hours later than EST.

conditions than reception of the Latin American stations reported last month.

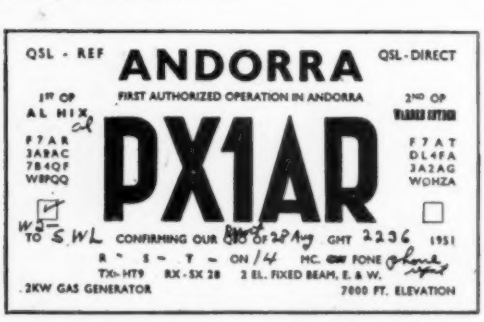
During July, 14-mc. band European stations should be heard in Eastern and Central USA at 0600-0900 and 1400-2000 EST, with best reception at 1500-1800 EST. In the Western USA, Europeans should be heard irregularly at 1300-1700 PST.

The most frequently heard European countries are England (G), France (F), Germany (DJ-DL), Italy (I), Portugal (CT1), Spain (EA), and Switzerland (HB). Other countries that are not too difficult to hear are Belgium (ON4), Denmark (OZ), Ireland (EI), Netherlands (PAø), Scotland (GM), and Wales (GW). The remaining European countries are more difficult to hear, except where one particularly active station (such as CS3AC—a U. S. Air Force ham station in the Azores, or OE13USA—a U. S. Army ham station in Austria) provides more frequent reception than would normally be expected from that country. Amateur stations in the Eastern European countries are rarely heard on phone at present, but there are a few stations operating on c.w. in these countries.

Here are some of the rare European countries to listen for:

Liechtenstein — Situated between Switzerland and Austria is the tiny principality of Liechtenstein, with an area of only 62 sq. miles. Amateur radio activity is provided occasionally by a Swiss amateur, who takes a portable transmitter along while on vacation there; so watch for Liechtenstein this summer. The most recent operation was by HB1MX/HE1, heard on 14.14 mc.

Monaco—Another tiny principality which has depended mainly on visiting operators for amateur activity is Monaco, on the south coast of France, best known for its gambling casino at Monte Carlo. However, the *Radio Amateur Call Book* now lists several stations with Monaco addresses, including 3A2AU, 3A2AX and 3A2BA; so one of these may provide reception from this rarely heard country.



This QSL is from the very rare country of Andorra. Ham operation resulted from the visit to this country by Al Hix, W8PQQ.

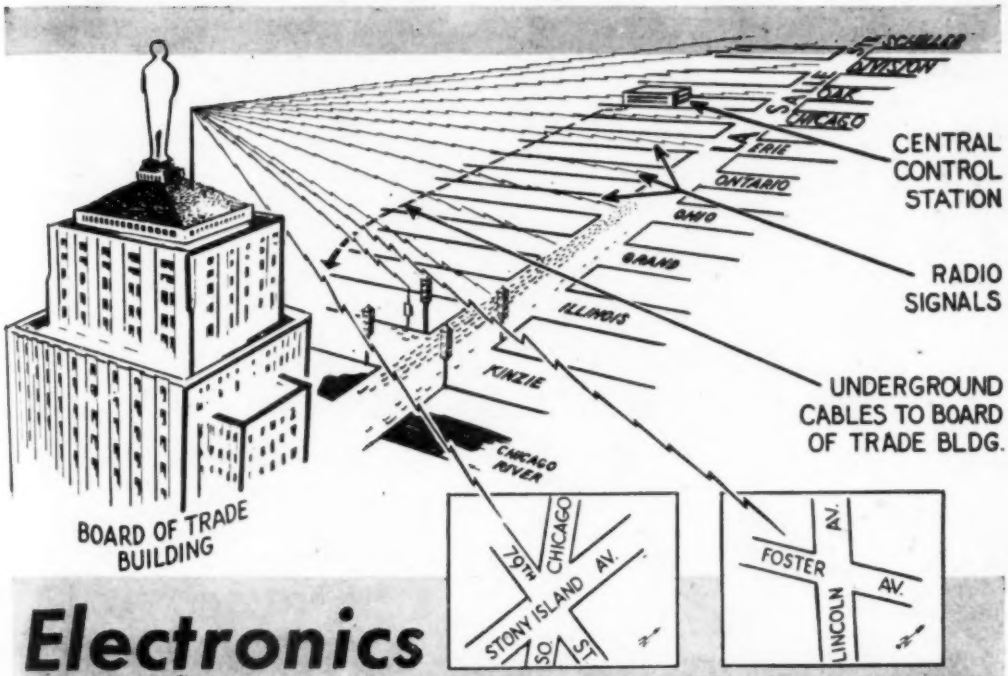
San Marino—The independent republic of San Marino, located in the mountains of eastern Italy, is represented on the amateur bands by M1B. He apparently does not operate too often, but when he is on, he seems to put through a good signal. Watch for M1B around 14.16 mc.

Sardinia—In the Mediterranean, west of Italy, is the island of Sardinia, whose amateurs can be distinguished from the more numerous Italian stations by their use of the IS1 prefix. The Sardinian station most recently noted was IS1BV on 14.19 mc.

Other European Countries — The following are stations heard recently from other European countries, arranged alphabetically by call letters. The frequencies noted are subject to variation, due to use of variable frequency control.

CT1 (Portugal): CT1CL, 14.18; CT1EX, 14.175
CT2/CS3 (Azores): CS3AC, 14.32; CT2AG, 14.14
DL/DJ (Germany): DJ1ZH, 14.18; DL4FH, 14.16
EA (Spain): EA2AS, 14.14; EA4BF, 14.11
EI (Ireland): EI4J, 14.11; EI6E, 14.14
F (France): F7SHP, 14.16; F9RM, 14.17
G (England): G2AMG, 14.17; G3DO, 14.19
GC (Channel Islands): GC3EBK, 14.18; GC6FQ, 14.13
GD (Isle of Man): GD3IBQ, 14.12; GD3UB, 14.11
GI (Northern Ireland): GI3CWY, 14.19; GI3GXP, 14.15
GM (Scotland): GM6HW, 14.16; GM8MN, 14.19
GW (Wales): GW3EHN, 14.13; GW4CZ, 14.12
HB (Switzerland): HB9JZ, 14.19; HB9KM, 14.19
I (Italy): I1BDV, 14.185; I1TDJ, 14.15
IT (Sicily): IT1BXX, 14.18
LA (Norway): LA3G, 14.14; LA4KD, 14.10
OE (Austria): OE13JM, 14.20; OE13USA, 14.31
OH (Finland): OH5NQ, 14.11; OH9OC, 14.13
ON (Belgium): ON4CR, 14.11; ON4VK, 14.15
OZ (Denmark): OZ3Y, 14.14; OZ9G, 14.16
PA (Netherlands): PAøJG, 14.14; PAøULA, 14.19
SM (Sweden): SM5LL, 14.16; SM6SA, 14.30
SV (Greece): SVøWM, 14.13; SVøWS, 14.18
TF (Iceland): TF3MB, 14.14; TF5SV, 14.12
YU (Yugoslavia): YU1GM, 14.16; YU2DB, 14.16
ZB1 (Malta): ZB1AJX, 14.14; ZB1CM, 14.12
ZB2 (Gibraltar): ZB2A, 14.12
9S4 (Saarland): 9S4AQ, 14.19; 9S4CG, 14.16

Enjoy yourself listening to the Europeans. Next month we will have some tips about hearing stations in Africa. —30—



Electronics Controls City Traffic

Coded radio signals activate traffic lights in system that is better and cheaper than conventional controls.

AFTER trying every known method of traffic control, Chicago authorities have decided that electronics can succeed where all else has failed. The largest of its kind in the world, a system which utilizes radio waves to regulate traffic on busy city streets is expected to be in operation this summer.

The City of Chicago has been authorized to transmit radio signals for traffic control purposes. A 250-watt FM transmitter will operate on 27.255 mc. The antenna, atop the Board of Trade Building, will tower 605 feet above the ground. This point is connected by cable to "Central Control" at the Bureau of Electricity, 405 West Chicago Avenue.

"Central" transmits coded radio tone signals to receivers located at critical intersections. Each receiver is equipped with a decoder which responds only to messages intended for its particular corner. The traffic control light at that corner is then actuated. A signal intended to operate the light at any given corner will be ignored by the mechanisms at all other corners.

Electronic devices enable the best signal timing to be put into operation automatically each day, modified as necessary for traffic movement and weather conditions. Current plans call for three automatic changes each day.

Thus far, of the 3000 stop-and-go signals in service, 450—at intersections of heavily unbalanced traffic—are equipped with radio control. If conventional methods were used to connect these 450 signalized intersections using cable, the estimated cost would be $3,375,000—many times the cost of using radio control to do the same job.

The Chicago system, engineered and set up by the *General Electric Company*, may well set the pattern for traffic control by electronics all over America. —30—

DISTORTION in Hi-Fi equipment

(PART 2)

By NORMAN H. CROWHURST

SOME OF our readers will probably remember when early radio, phonograph and telephone instruments were hailed as being so lifelike in their reproduction that they virtually eliminated time and distance. Of course they weren't *quite* perfect in those days, but pretty close to it. Since then we have come a long way in reducing all kinds of distortion, but we still fall short of *perfect* reproduction. The human ear is both an extremely tolerant and an extremely critical "instrument."

As already pointed out (POPULAR ELECTRONICS, June, 1955, p. 73), frequency response is the quality about reproduction which can be most readily identified. A simple audio oscillator, vacuum-tube voltmeter, and an oscilloscope may be used to view program waveforms, and to make simple listening tests; but there is another way of checking frequency response.

Square Wave Testing

This method employs an oscilloscope with a different kind of oscillator: instead of using a pure sine-wave tone, the waveshape is electronically changed into a square wave. Mathematicians have shown that a square wave can be synthesized by adding together a whole family of sine waves whose frequencies are related in proportion to the odd numerals 1, 3, 5, 7, etc. Figure 1 shows some of these component waveforms building up towards an ultimate square wave.

When a system has a perfectly flat fre-

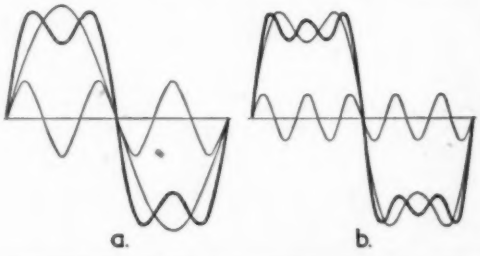


Fig. 1. Square waves are formed by a series of frequencies or harmonics of the same frequency. At (a), the fundamental is being combined with its third harmonic; the resultant wave is shown as the heavy line. At (b), the resultant from (a) is combined with the fifth harmonic to produce another heavy line that more closely resembles the square wave.

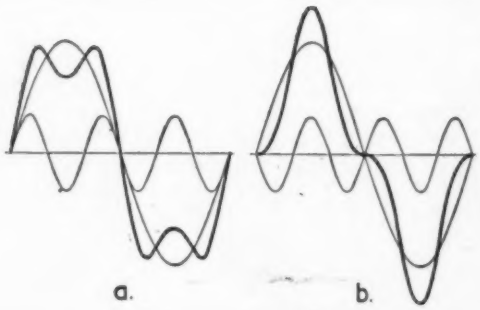


Fig. 2. This is a demonstration of phase in waveshaping. Part (a) is identical to (a) above, but in (b) of this drawing the timing, or phase, of the third harmonic has been slightly shifted. The resultant wave drawn as the heavy line is now quite a different shape and could not be classed as a useful square wave for testing hi-fi equipment.

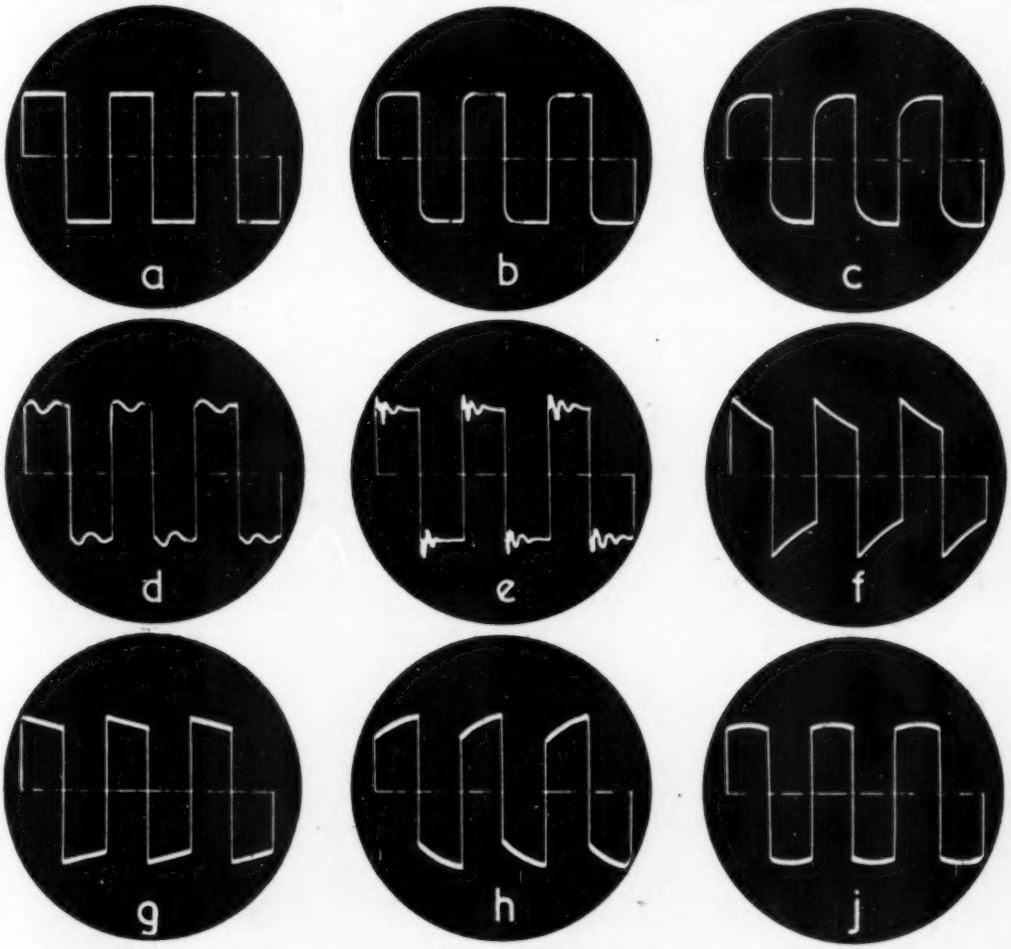
In the second part of this series, the author discusses distortion and how it is found in hi-fi equipment with square wave tests.

quency response, a square wave applied to its input will produce a square wave at the output. But any deficiency or over-emphasis of some of the frequencies will change the shape of the waveform because all the component frequencies will not be uniformly amplified. Thus, frequency response can be judged at a glance, without having to plot out a number of points on a graph. But this method of testing not only shows up discrepancies in frequency response; it can also be used to identify a number of other defects, including an associated form of distortion that is sometimes important and which is known as "phase distortion."

Phase Distortion

This form of distortion occurs when all the component frequencies in a waveform

Fig. 3. Examples of oscilloscope traces during square wave tests. At (a), the undistorted square is shown. Trace (b) has a cut corner, indicating a little high frequency loss and phase distortion. At (c), a greater amount of high frequency loss is shown. Trace (d) shows too much high frequency response, or "ringing" in the amplifier. At (e), the same effect is pictured with slightly different amplitude and frequency. Drawing (f) represents low frequency loss and associated distortion, while (g) shows low frequency phase distortion without appreciable loss. Trace (h) depicts low frequency amplitude with phase distortion. At (j), there is low frequency accentuation with no phase distortion.



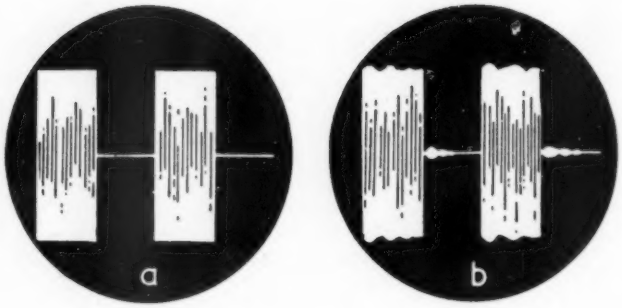


Fig. 4. To determine the presence of transient distortion, a high frequency audio wave in (a) is being switched off and on at regular intervals. The pattern is essentially square. In trace (b), the same wave pattern is shown after passage through a hi-fi system having a small amount of transient distortion.

do not arrive at the output with the same timing that they had in the input waveform. The effect of this change is illustrated in Fig. 2A, where a waveform made up of a fundamental and third harmonic is shown together with its component sine waves. This might be the input waveform. Figure 2B shows the effect of changing the phase of the higher frequency relative to the lower one without changing amplitude. Note that the composite waveform looks completely different from the original one, although the relative amplitude of the two component frequencies has not been changed.

The oscilloscope provides a particularly good way of observing this change in phase relationship, and is probably the simplest means of detecting phase distortion. This kind of distortion is unnoticeable to the ear until one of the frequencies has changed its timing by the equivalent of several complete periods or waves.

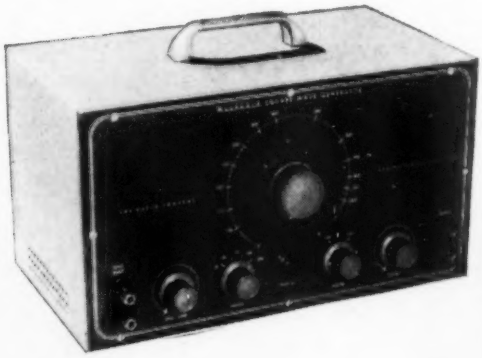
Transient Distortion

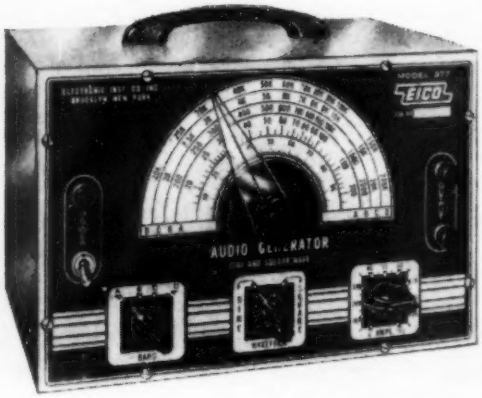
A third form of distortion that shows up quite well with square-wave oscilloscope testing is called "transient distortion." This term is used to describe a form of distortion that sometimes appears when frequency response is apparently perfectly flat within the audio range with which we are concerned. Although the equipment gives a flat response when measurements are made with a steady tone of sine waveform being applied at different frequencies, it may not behave so well when the tones are applied suddenly in short bursts, or when a tone first starts.

Distortion of this kind can be particularly detrimental to the reproduction of music from percussion or string type instruments. It can be demonstrated or detected by the use of square waves because the wave departs from a square in a manner different from the departure caused by deficiency in frequency response. Such detection is illustrated by the group of waveforms shown in Fig. 3.

Another method of detecting or demonstrating transient distortion uses a short burst of tone at a particular frequency. Here the envelope, or outline, of the input wave is rectangular but the output—instead of being rectangular—shows a kind of bounce effect, as illustrated in Fig. 4. This is the particular aspect of transient distortion that makes reproduction of instruments like the piano sound unreal.

(*Continued on page* 106)





These two instruments are readily available kits for the experimenter and technician. Above is the HEATHKIT square wave generator Model SQ-1. At right is the EICO generator for both square and sine waves, Model 377. Both are reasonably priced and may be assembled in a few evenings of soldering and wiring.

WHAT'S THE PE ANSWER?

Two-Way Mobile Radio

Reading about the small transmitters and receivers, I was wondering if you have anything on a cheap two-way radio that we can install in our 1954 stock racing car. We cannot afford the sets they have on the market.

We would appreciate it very much if you could suggest some cheap kits that we could install. They would have to operate on 6 volts, as you know the automobile set can only operate on 6 volts; and the other set operated by the mechanic must be light and portable as there will be no electricity available in the pit.

ZENO SOLTYSIK
Chicago, Ill.

Commercial two-way mobile radio equipment is quite expensive, and a license to operate such equipment may be difficult to obtain. The best solution to the above problem is for both the car driver and pit operator to obtain a suitable amateur radio operator's license, and to build equipment for operation in one of the mobile ham bands. Home-constructed units for this purpose have been described in our sister publication, RADIO & TELEVISION NEWS, as well as in the various radio amateur handbooks.

Loudspeaker Impedance

I have several speakers and I would like to determine what their impedance is. First of all, when it is stated that a speaker has a 6-ohm voice coil, is this 6 ohms d.c. resistance or inductive reactance? If inductive reactance, at what frequency is it measured? Does d.c. resistance have a fixed relationship to the inductive reactance?

CONRAD R. ROUX
Lewiston, Maine

In general, the impedance rating of a loudspeaker represents the actual impedance at some nominal value of frequency, usually 400 cps. Although this impedance is not directly related to the d.c. resistance of the voice coil, it usually turns out that the actual impedance is about 10% greater than the d.c. resistance. A simple method of determining voice coil impedance, then, is to measure the d.c. resistance and increase this value by 10%. Such a value is not exact, but is close enough to determine which tap to use on the output transformer.

100-540 Kc. Band

All home receivers that I have read about in your ads, and in other magazines about radio, give the band coverage as approximately 540 kc. and up to 1650 kc., then into the megacycle range. I wish to know if (A) there is a commercial receiver on the market which will pick up from, let us say, 100 kc. up to the 540-kc. area of the band, and (B) if there is not—is there a circuit available (of which I can purchase a copy) which could be reasonably easily built at home and which would pull in this band area.

MYER EHRLICH
Dorchester, Mass.

Very few commercial receivers cover the 100-540 kc. band because there is little of interest in this band for the casual listener. A variety of allocations have been made in the region from 10 kc. to 535 kc., including radio navigation; land, maritime and aeronautical mobile communications; and fixed communications stations. Most transmissions in this band are c.w., further minimizing the casual listener interest. Thus, there have been very few construction articles published on this type of equipment.

Balancing Push-Pull Stages

My problem is—what measures should be used in adjusting the bias on each tube of a push-pull output stage. Over the years I have read articles which state that adjustment should be made so that a zero voltage reading shows from plate to plate of the output tubes; others state that adjustments should be made so as to cause each tube to draw exactly the same plate milliamps. Which is correct?

DAVID J. HOFER
Stewart Manor, N. Y.

The conventional technique for balancing the push-pull output stage of an audio amplifier is to adjust the bias so that each tube draws the same current. This is a static balance, but it is adequate for most applications. For a dynamic balance, a signal is impressed on the amplifier input, the volume control set at a relatively high level, and the bias adjusted so that there is no a.c. signal at the center-tap of the output transformer. This can be determined by placing a series resistor of about 100 ohms in the "B+" lead. An oscilloscope connected across this resistor should not show any deflection when the stage is dynamically balanced.

Watt-Hour Meter Check

Please tell me how to check a watt-hour meter to see if it functions properly. Years ago I found directions in a magazine for checking watt-hour meters by using a bulb and a watch. However, I forget what size the bulb should be and what it should count to a minute.

JOSEPH KORMENDY
Selby, S. D.

An approximate check on a watt-hour meter may be made by using a 100-watt light bulb for a load, and operating this load for a known period of time. For example, if the load is connected for exactly one hour, the watt-hour meter should indicate 100 watt-hours. Employing this same principle, any known load may be connected for a known period of time, and the watt-hours calculated by multiplying the wattage rating of the load by the time in hours. The watt-hour meter should indicate this value quite closely if it is operating properly. —30—

The shortcomings of early recorders led to the development of modern units.

Recorders of Yesteryear

By NORMAN GARRAHAN

ALTHOUGH we are inclined to think of tape recording as a modern post-war development, actually the idea of recording magnetically on wire or tape is quite old—the art dating back to the 19th century.

One of the first wire recorders ever built was the "Telegraphone." Designed by Valdemar Poulsen of Denmark, it was manufactured in this country by the *American Telegraphone Company* around 1920. It was one of ten machines purchased and successfully used by the Department of Agriculture in Washington, D. C. As shown in Fig. 1, the spools of wire are mounted horizontally and turned by a husky 100-volt motor. No provision for automatic rewind was made, it being necessary to interchange the spools once for rewind and again for playback.

Lack of suitable vacuum-tube amplifiers and the heavy gage wire used hindered its widespread adoption. The writer managed to make this machine work and was surprised to find a recording still impressed on the wire. Someone back in 1925 had recorded a radio broadcast from station WMAL, then located in the Hamilton Hotel in Washington, D. C. Although a high background noise was present, one could clearly hear a "whodunnit" murder mystery *à la* 1925, followed by a commercial for the *Holmes Bakery* (still operating in Washington) and some jazz music played by an unidentified orchestra.

One of the shortcomings of the early wire recorders was the placing of the spools of wire in a horizontal plane. This caused loops of wire to pile up at the bottom of the spools, which resulted in snarls and breakage. An attempt to correct this deficiency was made in a succeeding machine, shown in Fig. 2. Note here that the wire spools are mounted in a vertical plane, thus permitting the soundhead to move back and forth distributing the wire evenly over the axis of the spool. Compare these two machines with the modern tape recorder shown in Fig. 3.

During the first 40 years in the development of magnetic recording, a d.c. bias was used (mixed with the signal) to improve the signal/noise ratio. This method was discarded in 1945 in favor of a.c. ultrasonic bias (generally 35 kc.) which, records show, was suggested by a U. S. Navy engineer in 1921.

The 1930's showed rapid advances in the technique of magnetic recording—in line with the appearance of satisfactory electronic amplifiers and improved ferromagnetic materials. Solid metal tape was tried and discarded as too impractical, and research was directed to the developing of small diameter wire (.004 inch) with the necessary strength. Wire itself, however, is being rapidly eclipsed by the perfection of red oxide-coated plastic tape with its higher fidelity. —30—

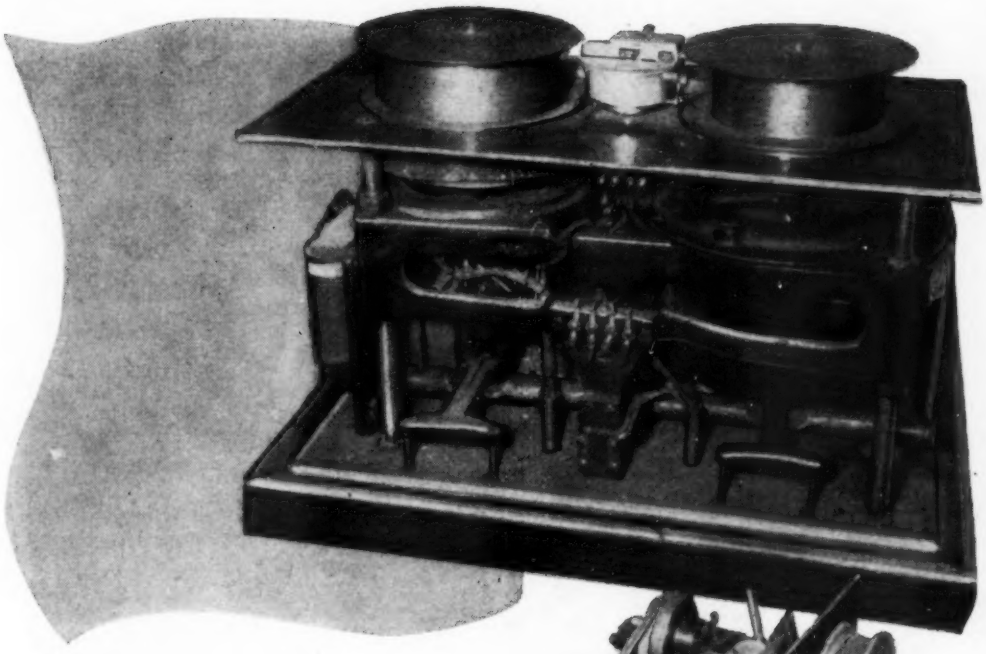


Fig. 1, above, shows one of the first wire recorders ever made in this country, vintage 1920. Difficulties created by horizontal position of wire spools led to development of succeeding machine shown in Fig. 2, right. Advantage of vertical mounting of wire spools is explained in text. Same unit, with cover on and ready for use, is shown in photo below, left.

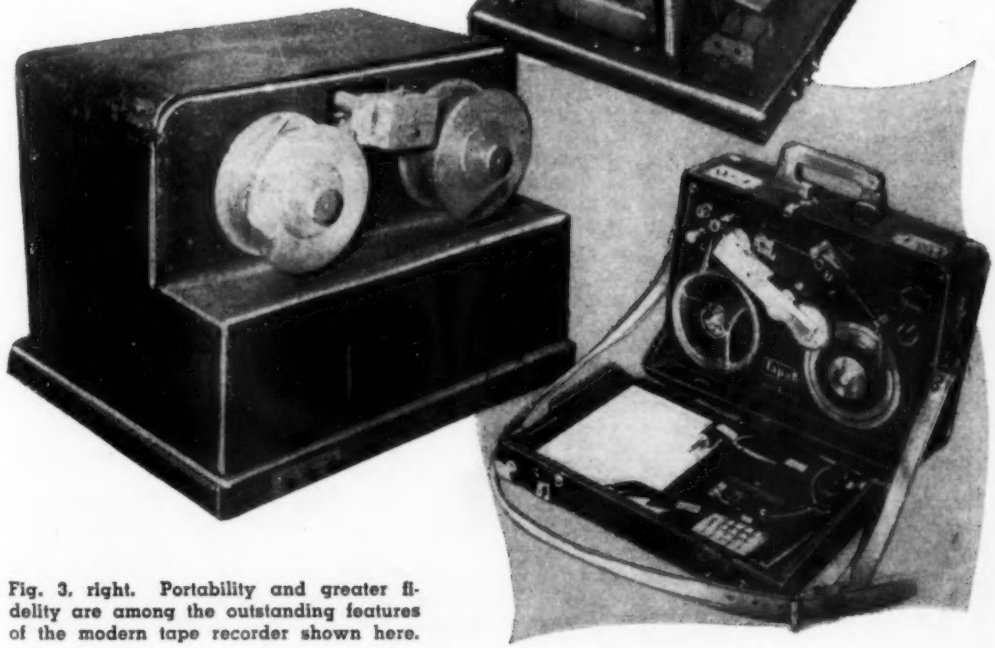


Fig. 3, right. Portability and greater fidelity are among the outstanding features of the modern tape recorder shown here.

Leader and timing tape ("Scotch" No. 43) is joined to magnetic tape by the same editing technique used in splicing any two sections of magnetic tape. Best connection is made with splicing tape.

LEADER AND TIMING TAPE

This accessory permits tapes to be timed, labeled, threaded, and cued. It will also check the speed of a tape recorder.

AS THE TAPE recordist gains experience, he will find that correct use of accessories can add to his enjoyment and improve the quality of his work. No longer in the exclusive domain of the professional recording engineer, for example, is the splicing tape used in editing. This pressure-sensitive tape will not gum up the recording head. It makes possible clean, noise-free splices, and eliminates the layer-to-layer adhesion common to ordinary cellophane tape. Aside from editing, splicing tape is essential in case a tape breaks.

Another work-horse of tape-recording professionals, which can be used to great advantage by amateurs, is "Scotch" brand No. 43 Leader and Timing Tape. This product can add mileage to magnetic tapes.

Tough and made of high-impact strength paper, No. 43 tape has several uses. It is printed with plaid sections spaced precisely 15 inches apart. This provides a simple method of controlling the time between selections. It also furnishes ample space for labeling each selection.

When attached to the beginning and end of a magnetic tape, No. 43 permits use of the full length without running it off the reel. It also provides for easy threading of tape onto the take-up reel and eliminates the hazard of tearing a piece of magnetic tape at the end in threading it.

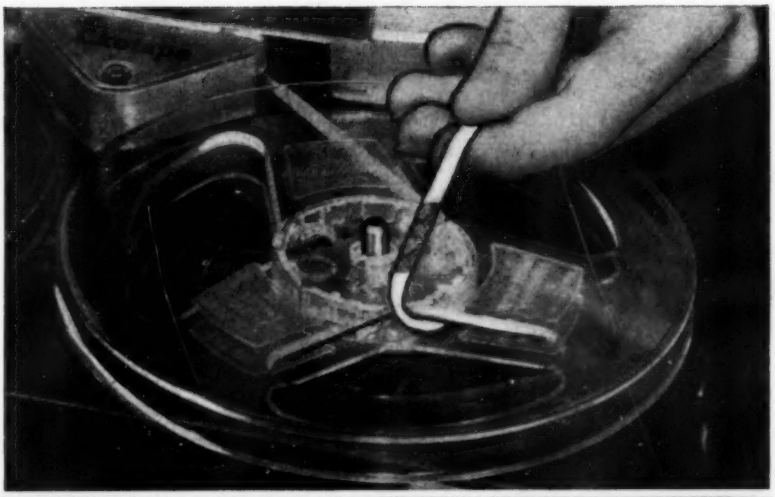
CBS technician Joel Tall, a pioneer in tape recording and editing, and author of the new *MacMillan* book "Techniques of Magnetic Recording," says that he uses as much as 10 to 15 seconds' worth of leader tape wherever possible. He claims that it assures a clean start during playback. Furthermore, it avoids the whipping action at the end of a reel, when the tape unwinds at high speed.

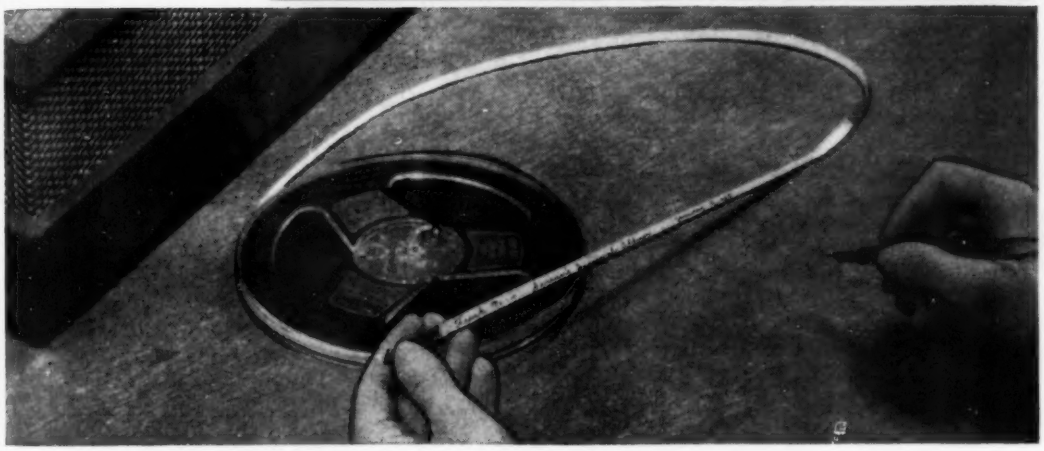
"Show-Building"

In professional broadcasting, leader and timing tape is indispensable for "show-building." It lets the user keep track of the different selections on the tape, and also allows technicians to "cue-up" for a quick start. This application is invaluable since a single half-hour radio show may use as many as 70 different selections spliced together.

Radio tape editors generally separate each selection with a "cue tape," as they call this within-the-reel use of paper leader tape. They write the number and description of each selection on a separate cue sheet and mark the corresponding number on the cue tape preceding the recording. When they want to locate a particular passage, they move the

Threading magnetic tape onto the take-up reel using leader and timing tape. This accessory also permits use of the full length of the recording tape without running it off the reel during recording or playback.





The smooth writing surface of No. 43 tape accommodates pen or pencil marking. Using it for labeling programs recorded on tape helps identify their contents. It also facilitates locating individual selections when several are recorded on one reel.

tape at high speed and simply count off the number of white spaces as they go past the head, until they arrive at the right spot. Two seconds' worth of cue tape is fairly standard, but as little as half a second can be used to move up the tape fast.

For the amateur who is building any kind of "album" on tape, the use of cueing tape will simplify the problem of cataloging and rapid identification of recorded material. Cue "sheets" can be kept on a separate piece of paper or on the labeling space on the back of the tape carton.

Checking Recorder Speed

Joel Tall also recommends the use of No. 43 tape for checking the linear speed of a tape recorder. This is how he does it: using a stop watch, he starts the tape rolling with a plaid section of timing tape showing just past the head assembly. He lets the machine run for several minutes while he counts each red section.

At the end of two minutes, if the machine has been running at precisely 15 i.p.s., the eighth plaid section will appear in exactly the same position occupied by the first section when the machine was started. If the speed is 7½ i.p.s., the sixteenth section should be showing.

If the tape halts in between sections, he marks the point with a black pencil and then measures off the distance to the eighth (or sixteenth) section. In this way, he can tell exactly how slow or fast the recorder is running, and have it adjusted if necessary.

"Scotch" brand No. 43 Leader and Timing Tape, made by the *Minnesota Mining and Manufacturing Co.,* comes in ¼" by 150' reels in a dispenser-type carton and sells for 60 cents. —30—

The experimenter attaches headphones and listens for a null which indicates the frequency of audio input.

"Simple Audio Frequency Meter"

By RUFUS P. TURNER

Two resistors, two capacitors, and a dual potentiometer make an easily duplicated unit for measuring audio frequencies.

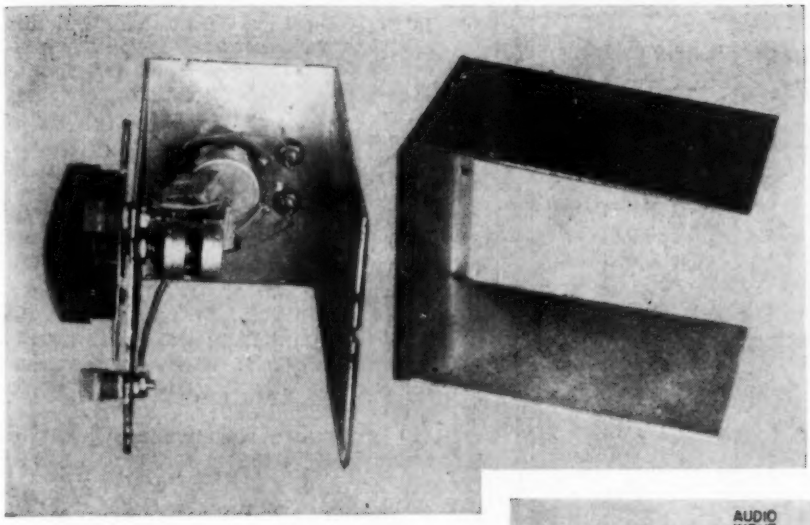
ANY audio frequency between 50 and 10,000 cycles can be measured with the simple test instrument described in this article. It is as easy to use as the radio-frequency wavemeter described in the November, 1954, issue of POPULAR ELECTRONICS (page 80), and matches it in size and appearance. With these two instruments, the experimenter can measure a wide range of both audio and radio frequencies. The audio frequency meter allows the hobbyist to measure the tone frequency of audio oscillators, electronic music makers, heterodynes, etc.

Circuit Description

The audio frequency meter is operated by adjusting a dial to *tune out* the "unknown" signal fed into the instrument. At the point where the signal disappears (or suddenly drops quite low in volume), the frequency is read from a calibrated dial. Figure 1 shows the wiring diagram. This is the widely used Wien bridge circuit. The property of this circuit which makes it useful as a frequency meter is its ability to null (tune out) any single-tone audio frequency signal. This is accomplished by simultaneously adjusting the dual ganged potentiometer *R4-R5*. A dial attached to the two-gang potentiometer unit may be made to read directly in cycles or hundreds of cycles.

Because inexpensive two-gang potentiometers cannot be made to agree exactly at all settings, an auxiliary potentiometer, *R1*, is included in the circuit. Adjustment of *R1* helps to tune the signal out completely so that the exact null point can be recognized, but has little or no effect on the reading of the frequency dial attached to *R4-R5*.

Headphones, connected to the output terminals, can be used with the frequency meter. An a.c. vacuum-tube voltmeter (v.t.v.m.) also can be used and will show the null point somewhat better than the headphones. This frequency meter will operate at frequencies lower than 50 cycles, but most headphones will not give an audible signal below about 50 cycles. However,



This frequency meter may be built into any convenient chassis box. Shown at the left is an ICA "Channel-Lock" measuring 5" x 4" x 3".

the v.t.v.m. will operate at any frequency within the instrument range.

Construction

The frequency meter is built in an aluminum chassis box 5" long, 4" wide, and 3" deep. Mounted on the top panel is the two-gang 0.5-megohm potentiometer, *R4-R5*, and the two insulated *INPUT* binding posts. The 1000-ohm potentiometer, *R1*, and the two insulated headphone pin jacks are mounted on the rear panel. Layout of parts and wiring details are shown in the pictorial diagram.

Resistors *R2* and *R3* should have as nearly as possible the exact 1000- and 2000-ohm values specified, even if they are not precisely 1000 and 2000 ohms. Resistor *R3* should be exactly twice resistor *R2* in ohmic value.

The main dial attached to potentiometer *R4-R5* is a 3½"-diameter unit (*National* Type O). A disc of plain white paper is cemented to the metal plate of the dial, and this disc is marked off during the calibration. No scale is needed for potentiometer *R1*, so an ordinary finger-grip knob is used.

Wiring is not critical. However, it should be done solidly with insulated hookup wire, and the leads should be run directly by short routes between circuit points. It will be noticed that the capacitors (*C1* and *C2*)

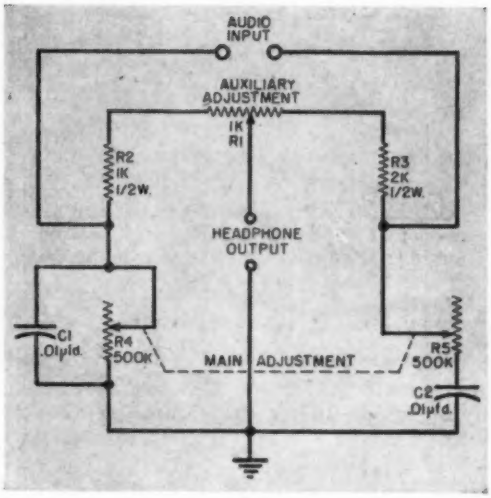
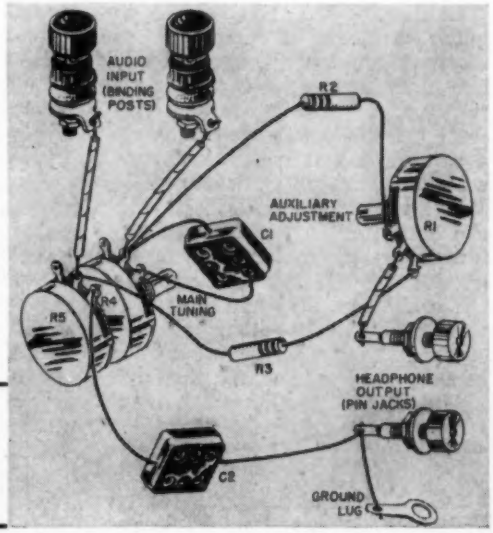


Fig. 1. (Above) Wiring schematic.

At the right is the pictorial diagram, and the parts list is given below.

C1, C2—.01 μfd., 200 v. mica capacitors
R1—1000 ohm wirewound potentiometer
R2—1000 ohm, ½ w. carbon res.
R3—2000 ohm, ½ w. carbon res.
R4-R5—Dual 500,000 ohm potentiometer (IRC Type 13-133)



Frequency Chart

Frequency (cycles)	*Resistance (ohms)*
50	320,000
60	265,000
70	230,000
80	200,000
90	175,000
100	160,000
200	80,000
300	53,000
400	40,000
500	32,000
600	26,500
700	23,000
800	20,000
900	17,000
1000	16,000
2000	8000
3000	5300
4000	4000
5000	3200
6000	2650
7000	2300
8000	2000
9000	1700
10,000	1600

Calibration of the frequency meter may be performed with an ohmmeter. The author used a Simpson 260. Following the procedure outlined in the text, the ohmic values shown above approximate the resonant or null audio frequencies of the circuit.

and resistors (*R2* and *R3*) are connected by means of their own pigtails.

Calibration

After the instrument has been wired, close the box and mount the dial tightly to the shaft of potentiometer *R4-R5*. The instrument now is ready for calibration.

Calibration is performed best with an audio oscillator. If there is no audio oscillator at hand, one can probably be borrowed from another experimenter for this purpose. Its tuning range should be at least 50 to 10,000 cycles. In lieu of an oscillator, a fair calibration can be made with the common ohmmeter.

Audio Oscillator Method: (1) Connect the oscillator to the *INPUT* terminals of the frequency meter. (2) Connect headphones to the *OUTPUT* terminals. (3) Set the oscillator to 50 cycles. (4) Adjust potentiometer *R4-R5* to a point where the signal suddenly disappears or at least drops to very low volume. If this null point is indistinct and broad, adjust potentiometer *R1* while adjusting *R4-R5*. (5) When the null occurs, pencil-mark this point "50" on the *R4-R5* dial. (6) Set the oscillator to 60 cycles, and readjust potentiometer *R4-R5* and potentiometer *R1* again for null. Mark this point "60" on the dial. (7) Repeat this procedure at as many frequencies as possible up to 10,000 cycles. If it is hard to hear the very high frequencies, use an a.c. v.t.v.m. instead of headphones and watch the meter for a sudden dip toward zero.

After the dial is completely marked in this manner, set it to its 1000-cycle point, remove it carefully from the shaft without disturbing the setting of the potentiometer, and ink in the inscriptions. Then replace the dial carefully in the 1000-cycle position, tighten it, and check the instrument with a 1000-cycle signal from the oscillator.

Ohmmeter Method: Without an oscillator, the resistance settings of either *R4* or *R5* may be checked with a good ohmmeter, and the resistance readings converted to frequency readings (for marking off the dial) with the aid of the Frequency Chart in the adjoining column.

Follow this procedure: (1) Temporarily disconnect capacitor *C2* from section *R5* of the two-gang potentiometer. (2) Connect one lead from the ohmmeter to the *R5* lug from which *C2* was disconnected. (3) Connect the other ohmmeter lead to the center lug of *R5*. (4) Refer to the Frequency Chart. Set the *R4-R5* dial for an ohmmeter reading of 320,000 ohms. According to the Chart, the dial should be marked 50 cycles at this point. (5) Next, set the dial for an ohmmeter reading of 265,000 ohms. From the Chart, mark this point 60 cycles. (6) Repeat at each resistance setting shown in the Chart, marking each dial point with the frequency shown in the Chart, up to 10,000 cycles (1600 ohms). (7) Reconnect *C2* to *R5*.

The resistance values given in the Chart have been checked carefully by the author with a *Simpson* Model 260 meter.

Use of Instrument

To use the audio frequency meter, connect the oscillator or other audio tone generator to the *INPUT* terminals of the meter. Connect headphones to the *OUTPUT* terminals. Adjust the main dial (*R4-R5*) to tune out the signal. If a clear tune-out is not obtained, also adjust the auxiliary potentiometer, *R1*, while tuning *R4-R5*. At the point where the signal disappears or drops to its lowest volume, read the frequency from the main dial.

If the frequency is so high or so low that the signal cannot be heard, use an a.c. vacuum-tube voltmeter in place of the headphones and adjust the frequency meter for the lowest downward swing of the meter.

Advanced experimenters should find this instrument useful but—at some future date—will undoubtedly want to invest in a frequency meter that reads the unknown directly on a meter scale. —30—

RECORDER and AMPLIFIER MIXER

By LOUIS E. GARNER, Jr.

This handy gadget can be built in a few hours and should be of special interest to the tape recording enthusiast.

MOST home amplifiers and recorders utilize single "mike" input jacks. Two "mike" inputs, however, are often desirable . . . . either for use of an "off-stage voice" in amateur theatricals, for providing sound effects (see "A Sound Effects Kit for Home Recordings," POPULAR ELECTRONICS, p. 56, January 1955), or simply to permit a large group to use the equipment at one time.

The "Audio Mixer" shown in Fig. 1 can double the number of mike inputs of any piece of audio equipment which now has a single high-impedance mike jack. What's more, it allows *individual* control over each mike input, permitting "fading." It is ideal for sound effects and for announcing musical selections.

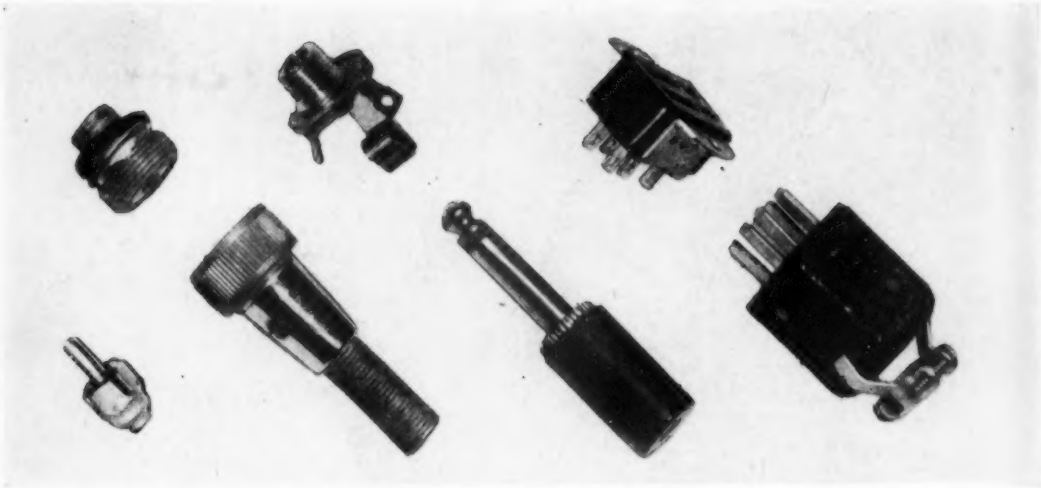
This mixer requires no circuit changes in present equipment, so don't worry about voiding a factory guarantee by opening the "works" of a new recorder. The unit simply plugs into the mike jack of the recorder or amplifier, and may be removed just as easily.

Parts cost is low and the unit is easy to assemble and wire. At current prices, all new parts should cost well under $5.00. Assembly time, for the average experimenter, should not run over two to three hours.

Material needed for assembling the mixer is specified in the parts list. *However, before purchasing the plug or jacks, check on the connectors used on the audio equipment and microphones.* The model shown uses a phone plug and jacks to match the equipment with which it is used. Other audio equipment may be equipped with a different type of connector—a *Jones* plug, a coaxial microphone connector, or some other type of connector.

Although a standard aluminum *Bud* "Minibox" houses the model, any small case is suitable. A plastic, or even a wooden, case may be used if the interior wiring is well shielded.

The underchassis view on page 83 should serve only as a guide, for exact dimensions are not critical, and considerable latitude in choosing parts location may be exercised by the individual builder. Either a larger or a smaller case size may be employed, provided there is room for mounting and wiring the components.



Examples of the many plugs and jacks used with tape recorders. The constructor must alter his mechanical arrangement to employ the proper jack with the mixer.

For a "professional" appearance, label the controls and inputs of the mixer. Use either metal name plates and dials or commercially available decals for this job. Decals were used to label the model. If decals are used, don't apply them until after machine work has been completed. After application, protect them with two or three coats of clear plastic spray or lacquer.

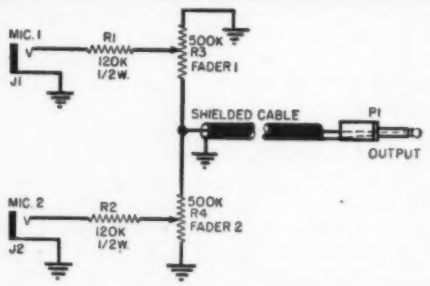
Some type of protection should be provided on the bottom of the case to prevent scratches to tables or cabinets on which the mixer may be placed. Rubber feet might be used, if available. Or, for an inexpensive substitute, use rubber grommets.

Wiring is straightforward and simple, requiring no special precautions. In the model, a piece of #12 tinned bus bar was run the length of the case and all ground connections were made to it.

How It Works

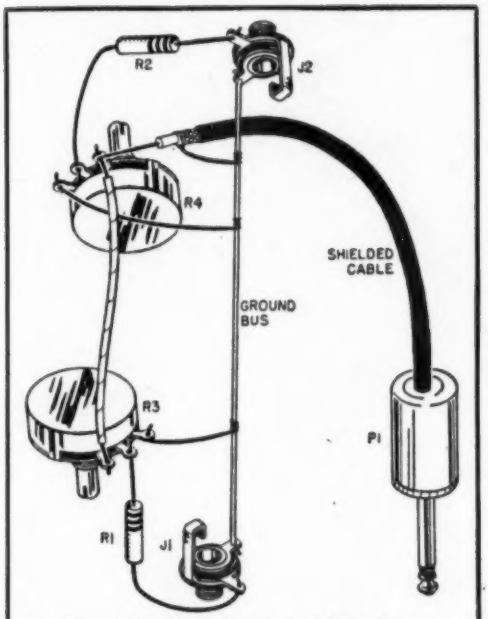
Referring to the schematic wiring diagram, mikes may be plugged into jacks *J1* and *J2*. Audio signals from the microphones are fed through resistors *R1* and *R2* to the center arms of "fader" controls *R3* and *R4*. Audio level obtained from each microphone now depends upon the settings of *R3* and *R4*. Either of the two inputs may be emphasized, both may be turned "off," or both may be turned to full volume, depending on how the controls are set. The combined signals are fed into the "mike input" jack of the recorder or amplifier.

In operation, resistors *R1* and *R2* serve two functions. First, they act in conjunction with their respective controls, *R3* and *R4*, to vary the output signal level. These series resistors also act as voltage dividers. As the center arm is moved up to increase volume, the resistance between the center arm and ground increases, and a greater portion of the available signal appears across the control. As the center arm is turned down to reduce volume, the resistance between the center arm and ground decreases, and less signal appears at the output. With the control arm turned all the way back, the signal from the mike is essentially grounded and the series resistors act as a load on the respective microphones. The second function of series resistors *R1* and *R2* is to serve as *isolation* resistors between the mikes, preventing

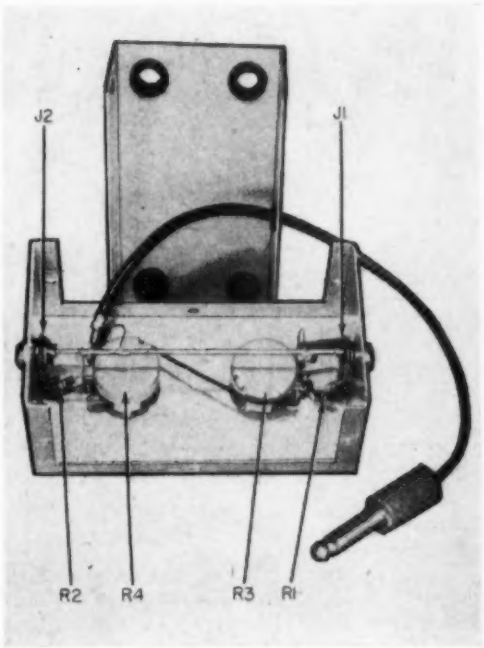


R1, R2—120K, ½ w. carbon resistors
R3, R4—500K carbon potentiometers, audio taper
J1, J2—Open circuit phone jacks (see text)
P1—Phone plug (see text)
4—½" rubber grommets
1—⅜" rubber grommet
2—Pointer knobs
1—Single-conductor shielded cable (12")
Misc.—Case—5¼" x 3" x 2⅛" (Bud Minibox #CU-2106; decals; wire; solder; screws, nuts, etc.

Fig. 1. Wiring schematic and parts list of the mixer. The author indicates that the total cost should be less than $5.00.



Pictorial wiring diagram of the mixer.



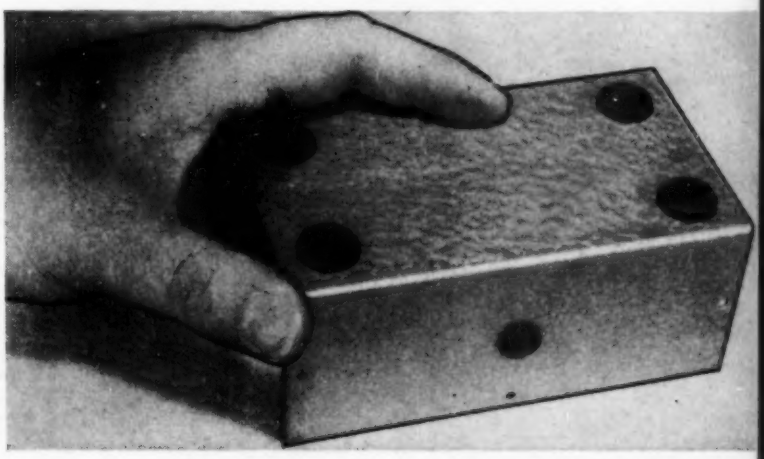
Underchassis view of mixer (above, right). Exact position of the two potentiometers is not critical. The author's potentiometers are equally spaced along one side with the input jacks at the ends. The cable to the recorder passes through a grommet in the side of the box. Use the proper plug for the tape recorder or amplifier at the end of this cable.

crosstalk even when both controls are turned up full.

Using the Audio Mixer

To use the mixer, connect the microphones to the input jacks and connect the output plug to the "microphone input" of the audio amplifier. Use the mixer's fader controls to vary the level of each mike, and the gain control on the amplifier as a master fader.

Instead of using the mixer to couple two microphones to an amplifier, it may be used to couple a mike and a record player —or mike and radio tuner. Thus, the user can announce musical selections or "break in" on radio programs. Obviously, there are many other possible applications for the mixer, and the constructor should have no trouble finding new ones for this unusual gadget. Such applications might include mixing two microphones for a public address system. Experimenters could also use this idea for mixing two inputs to an intercom where provision has only been made for one microphone. -30-



Drill four holes in the bottom of the metal box and insert rubber grommets to prevent scarring or scratching of furniture.

Scheme and Variations

By CARL KOHLER

Bringing hi-fi into the home can have interesting results.

AS IT MUST to all men whose lives are dedicated to filching spare time for electronic exploration, Hi-Fi finally came to my house . . . bringing with it a symphony of dissension.

Because explaining even the rudimentary principles of electronics to my wife is something along the order of expounding The Theory of Sonar Impulse to a troop of howler monkeys . . . I've given up appealing to her sense of logic. She just isn't wired for it. Instead, I usually throw a pitch couched in dulcet tones and calculated to make a shambles of her defenses.

However, all these high-pressure approaches are leaving me shorn of previous ability to express my ideas in simple language. Throwing myself into the part is fast becoming a habit. It's getting so I can't even suggest we have a shot of coffee without making a production of what used to be a casual recommendation.

About six weeks ago, I staggered home from my local radio jobber burdened with cartons and boxes containing enough hi-fi equipment to rig every room in the house for faithfully reproduced sound. I had become the victim of my own long-thwarted desires . . . plus the seductive verbal gyrations of a salesman who played upon my obvious wish-to-be-sold appearance.

I managed to get the stuff out of the car and into the den via the side entrance. Once I had it neatly stacked in an inconspicuous corner—where it towered to the ceiling—I sat down and began figuring how I might set up two separate books on the family budget. While I was juggling this bit of financial perfidy, the co-engineer stalked into the room . . . gave a shrinking look at the looming stack of supplies . . . put a lily-white mitt against the desk for support, and turned horror-filled eyes upon me.

"Oh, *no!* No, no, no!" she chirruped dismally.

I leaped up with shining face . . . enthusiasm popping out all over me under a slight veneer of cold sweat.

"Ain't it the greatest, kid!" I vowed, slapping her a good one across the shoulder blades to knock the shock out of her and put her gathering defenses off balance. "Boy, are we going to have a wonderful time! Once I get this hi-fi all installed, will we ever have a ball listening to music reproduced *exactly* as it was recorded!"

. . . Awed beyond argument, the wife left me to my tinkering for a week without interruption . . .

. . . I began planning several brick baffles, and she insisted on mixing the mortar . . .

"You m-mean—" her face was a study in accumulated disgust and fright, "—all this junk is strictly for listening to m-music? What's wrong with the record player we already have?" She was turning nasty.

"Hah!" I snorted with just the right amount of bitter contempt. "If you'd ever heard music played through hi-fi, you'd understand. Why, that ancient distorter of sound makes Beethoven's *Fifth* come out more like The Monkey Chased The Weasel. We lose all the delicate tones . . . the soft, intricate responses . . . the clarity . . . the sharp, clean beauty of blended brasses and strings mingling with soul-touching deftness through passages and phrases guaranteed to waft one off to auditory bliss."

"We *do*?" She was getting off balance.

"Sure, we do," I said darkly, lowering my voice to a hoarse whisper. "Most people never realize that they are missing the greater part of recorded music because—" and I brought her ear close to my lips, "—because they *never hear ALL the music on the platter!* Think *that* over, kid."

"Gee!" she whimpered. "I never realized . . ."

"Just a child . . . a sweet, innocent child," I crooned, stroking her head. "These harsh realities have to be faced, my dear. Never fear—I'll guide you through the pitfalls . . . the chasms."

Awed beyond argument, she left me to my tinkering for a whole week without interruption. I got the first unit installed by the time she shook off her daze. Now I would combat reluctance with Sound Proof.

Over the lilting measures of *Dance of the Hours,* I winked knowingly. "See what I *mean!*" I gloated. "Hear those subtle overtones . . . those tenuous strains."

"I don't hear a darn thing different," she said, pinning me with a gimlet eye. "I think you're just turning it up louder."

"You aren't *trying,*" I complained.

"Ahhhhhh, I never cared for this long-hair beat anyway," she snorted. "I like something bouncey! You got anything but that drag-stuff?"

I peered accommodatingly through the albums.

"How about *Incidental Music From A Dynamo Factory?"*

"Pure corn," she scoffed.

"Well, we have an excellent recording here of *Waves Lapping A Chorale Reef.* The restless effect of the voices is something that will never leave your—"

"Square, man, it's too square!"

It looked like a round disc to me, but I was losing ground and this was no time for pedantic discussion. I grubbed deeper into our library of waxed-delights.

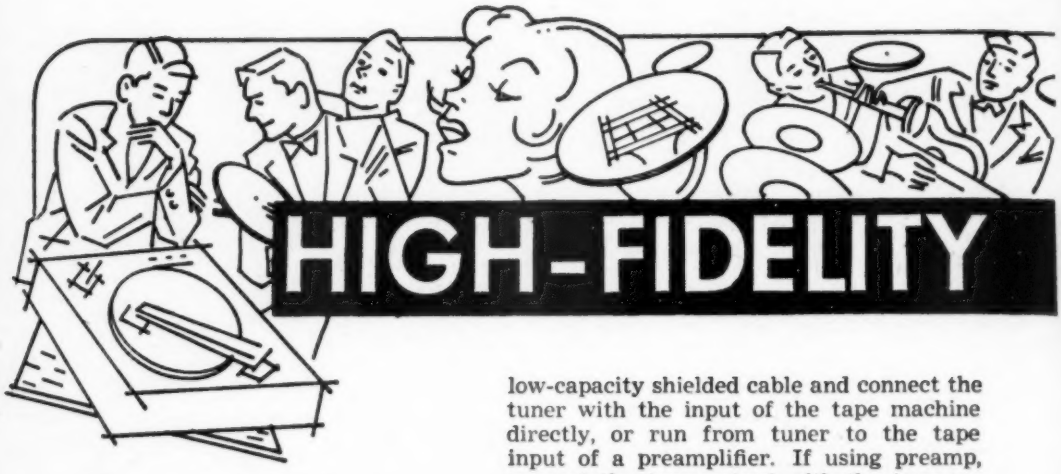
"Chamber Music for a Pack of Tone-Deaf Cowhands?"

"Now you're getting on beat, Jack!" she yelped. "Keep it up . . . keep digging!"

"Tonal Studies For Three Simmering Trumpets? . . . Hot Tea Bags For Ten Lonely Sidemen: A Jazz Joust Transposed In Flatted Progressives And Diminished

(*Continued on page* 105)

. . . A dream of long-standing—my very own ham station with my own call-letters . . .



HIGH-FIDELITY

Tape Recorders

YOU MAY recall that lack of space last month prevented me from giving you some basic ideas on tape recording techniques. I think the first consideration should be that of *"off-the-air"* recording. This is one of the most immediately rewarding things about owning a tape recorder . . . favorite programs can be recorded and played back almost indefinitely or the tape can be erased and new programs recorded.

The techniques involved are basic and simple. In fact, more really depends on the equipment than anything else. Almost any tape recorder with a high impedance input can be used, but the better the unit . . . the better the results.

Requirements of an FM tuner to produce high quality signals are pretty rigid. If you want really first-class *quiet* off-the-air recordings, a unit that has maximum sensitivity and selectivity is needed. Any well-constructed tuner that has a minimum specification of 5 microvolts for 30 db of quieting will be fairly satisfactory.

Of course, you must aid the tuner by feeding it a good signal from a high-quality FM antenna. If you live in a Metropolitan area, a simple dipole will probably prove effective. At distances of 20 miles and more, a good directional Yagi antenna—cut for the particular stations in your area—will be the best insurance for a quiet drift-free signal.

If the FM tuner you select has a.f.c. (automatic frequency control), this will lock stations in very nicely in urban areas. But make sure the a.f.c. has a "defeat switch"; otherwise, those of you living in suburban and out-of-town areas will not be able to tune in certain stations. This is due to a loss of selectivity.

Most tuners are now fitted with tape recorder output jacks. Obtain some good low-capacity shielded cable and connect the tuner with the input of the tape machine directly, or run from tuner to the tape input of a preamplifier. If using preamp, connect the *tape output* with the tape recorder input. The preamp setup allows you to "wire-in" the tape recorder as a permanent part of your hi-fi system, and permits record and playback functions merely by the selection of a switch position. Most important, it lets you hear and monitor the program you are recording.

If you own one of the less expensive home-type tape recorders, follow the directions given in the first article of this series on "magic-eye" technique (May issue). I'll remind you once again—*do not let the "V" of the eye close completely or overlap,* or you will distort your recording.

If you have one of the higher quality units which boasts a vu meter, you will be able to make good recordings with comparative ease. Listen to some music from the tuner and watch the pointer of the meter during the loudest passages. When the meter needle "peaks" zero, this will be the correct setting for obtaining recordings which have maximum level minimal distortion. *Don't touch your controls* or try to "monitor" the recording by dial-twiddling in an effort to maintain a constant zero level. The FM station tampers enough with dynamic range (in a restrictive sense), and you will only restrict it further by keeping the meter needle at zero level.

Well, that's about it for "off-the-air" recording. Yes, it is that simple. Just make sure the heads and capstans, etc., on your machine are clean, and with the equipment and techniques outlined you can make some wonderful tapes. A word of caution, however—all the best equipment and techniques in the world won't produce a high-quality tape if the material being broadcast is poor in quality.

Unless you live in "source cities," like New York, Chicago, Los Angeles, etc., most FM (and AM) material is *not* "live," but is usually recorded; or if it is a "live" trans-

(*Continued on page* 117)

By BERT WHYTE

REPRODUCTION

DISC REVIEW

AS PROMISED last month, we will review the recorded symphonies of the great modernist, Dimitri Shostakovich. Before beginning, I would like to tell you about some changes in the content of the "Disc Review" which will be inaugurated with this issue. I am not going to be able to write the "equipment" column on the opposite page any longer due to an expansion of some of my other activities. However, this column will be expanded somewhat, and will include such new features as jazz and "pop" reviews, an occasional fling with musical comedy, and a very substantial coverage of both classical and "pop" prerecorded tapes. One recording will be chosen from the classical and "pop" divisions each month and will be designated as the "Hi-Fi Record of the Month." These changes are in response to the desires of many readers as evidenced by their letters. It is through your ideas and suggestions that we can best serve you, so please do not hesitate to write.

Shostakovich Symphonies

The average hi-fi fan might be a little intimidated by such a formidable-sounding name as Shostakovich. It might conjure up all sorts of ideas about atonal, blatant, "screwball" modern music. Such fears are largely unfounded with the music of Shostakovich. Assuredly, there is atonality and dissonance, but these are subsidiary to the general essence of the music, which is—in the main—romantic. The music has a very high degree of "listenability," as evidenced by extensive use of thematic material from all of his symphonies as background music on many TV shows. Shostakovich has turned out ten symphonies so far and, of these, numbers 1, 5, 6, 7, 9, and 10 have been recorded.

Once again, we have a composer whose type of writing is particularly effective when recorded and reproduced with high-fidelity techniques. It is unfortunate that so few of Shostakovich's symphonies have been afforded modern high-quality recording. However, one can feel fairly certain that with the ever-increasing problems of duplication record companies will soon "rediscover" the works of the Russian master, and we will get some spectacular new recordings.

One of the most popular of the Shostakovich symphonies is his *First*, which many people also consider his best. This is a moot point and will not concern us here. As a high-fidelity vehicle, it is quite exciting. There are four recordings in the catalog, only one of which can truthfully be called hi-fi in sound. This is the Mitchell/National Symphony Orchestra effort on *Westminster* 5319. Here you have wide-range sound with clean crisp brass and woodwinds, and hugely proportioned percussion and string tone which is fine save for some occasional wiriness. Dynamic range is impressive and acoustics are quite expansive, giving a "big-hall" sound. Mr. Mitchell's performance is fairly straightforward, his tempi a little slow, and dynamic expression a little on the extreme side. The best performance by far, is the old Rodzinski/*Columbia* re-

(*Continued on page* 117)

Hi-Fi Record of the Month

Respighi—***Feste Romana***
Church Windows
Antal Dorati and the
Minneapolis Symphony Orchestra
Mercury Olympian MG50046

Tremendous! Overwhelming! A super hi-fi tour-de-force that will give the biggest speaker a good workout. Don't miss this one!

CARL & JERRY

By JOHN T. FRYE

Ultrasonic sound waves play a part in fostering romance—with unexpected complications.

THE SHADOWY coolness of Jerry's basement lab was a welcome relief from the shimmering heat outside. As Carl came in, he saw Jerry's rotund figure perched on top of a stool at the workbench, on which rested a delicate horn pan balance with a one-milligram weight in one of its pans. With a pair of tweezers, Jerry was carefully transferring some minute objects from a fruit jar lid to the other pan.

"Looks like you're really up to big business today," Carl observed. "What're you weighing, peach fuzz?"

"Nope, . . . mosquito cadavers," Jerry said, as his round face wreathed itself into an enigmatic smile.

Carl moved to the bench and peered down through his horn-rimmed glasses at the jar lid. Sure enough, in it were several rather badly mauled mosquito carcasses.

"Why?" Carl demanded.

"We-l-l-l," Jerry said hesitatingly, "It's a rather long story—"

"Never mind the buildup," Carl interrupted. "You know you're dying to tell me; so give."

"It all started a couple of nights ago. Looking out my bedroom window, I saw Norma, the girl next door, sitting on her porch swing, blubbering and crying away. Thinking that maybe she had locked herself out of the house or something, I went down to see what was wrong.

"It developed that a character by the name of Melvin Akers, who works at the bank, has her 'snowed.' For the life of me, I can't see why, for this Melvin guy is the sort even nature hates. He's allergic to anything that grows. He breaks out in a rash if anyone even mentions onions or radishes. She swears he can get ivy poisoning just from seeing the word 'ivy' in print.

"Even so, she has her mind dead set on marrying the creep; and that night she thought she practically had the job done. Melvin was in a rare mood—for him—with nothing to take his attention off her; and he had even made a couple of cracks about how pretty her hair looked in the moonlight.

"They sat down in the porch swing, and she started rehearsing mentally just how she was going to say 'I will' to his proposal. Then, all of a sudden, Melvin began slapping at his face and ankles, and suddenly stood up and said he had to leave. He's one of those people mosquitoes love to bite, and the bites swell up on him. So, he had to get home quickly and use some special ointment on them.

"That was why she was crying. She said she'd pinned her hopes on this moonlit porch swing setting all spring; and now that it had failed, she just knew Melvin would never propose."

"Why doesn't she try citronella?" Carl asked.

"I thought of that, too, but she says the odor clashes with her *Sweet Surrender* perfume, in which she has invested no small sum and which she is sure plays a big part in giving old Melvin the business. I told her I'd try to see if I couldn't think of something to help her."

. . . With a pair of tweezers, he carefully transferred the mosquitoes to the pan . . .

"How come you're so eager to play Cupid?" Carl asked suspiciously; "although I must admit you've got the figure for it. You going soft on this gal, too?"

"You got rocks in your head?" Jerry demanded witheringly. "She's practically an old woman. I'll bet she's 22 or 23 if she's a day. It's just that I don't like having someone bawling under my window when I'm trying to sleep. And then, her problem appeals to my scientific curiosity."

"How about Melvin? Don't you think it's playing it kind of low down to help trap a fellow man?"

"That bothered me a little until I happened to remember he was the local joker who wrote to the FCC and said he was sure we radio amateurs were interfering with his TV reception. All his trouble was being caused by an old-fashioned carbon filament light bulb in his basement. Some of those old bulbs act like miniature TV transmitters and cause interference to crawl up and down the picture."

"He deserves to get married!" was Carl's prompt, harsh judgment; "but how are you going to help with the mosquito situation?"

"I got an idea from something I read in RADIO & TV NEWS two or three years ago. You know sound waves can exert severe stress on objects that are resonant to the frequency of the sound. Remember how some opera singers can shatter a wine glass just by holding the right high note? Well, I think I can produce an ultrasonic sound wave at a frequency which will vibrate a mosquito violently and destroy him without people being able to hear the sound.

"Yesterday I borrowed a high-power movie sound system tweeter speaker from a projectionist friend of mind and hooked it across the output of my hi-fi amplifier. This amplifier has frequency response clear up to 100,000 cycles; so when I ran my audio signal generator into the front end of the amplifier, I got considerable power output from the speaker above the range of hearing. To check this, I suspended a tiny pith ball on a light thread in the path of the narrow cone of sound put out by the speaker and then varied the frequency of the signal generator. At certain ultrasonic frequencies, the ball was jerked back and forth so violently by the inaudible sound waves that it looked blurred. I'm sure that if I can hit just the right frequency I can exert several *G*'s of stress on a mosquito and shake him loose from his wings!"

"Why are you weighing the mosquitoes?"

". . . To get the average weight to use in the acceleration graphs and formulas for vibratory motion that I found down at the library. They're pretty hard to use, but if I do it right I should be able to figure out just the right frequency to apply maximum stress to a single mosquito."

As he talked, Jerry finally got the scales to show a satisfactory balance; and then he carefully counted the dead mosquitoes in the pan. Next he reached for his battered slide rule, made a few calculations, and jotted down some figures on a pad.

"We-l-l," he finally said hesitatingly, "if I've not slipped somewhere, it looks as though a frequency of about 19,000 cycles ought to do it. Tonight I'll run that frequency into the amplifier and direct the cone of sound from the tweeter speaker right at Norma's porch swing from my upstairs window. She says she'll maneuver Melvin into position there promptly at 10:30 if she has to chloroform him. I'll keep the mosquitoes at bay with my supersonic ray until Norma and her *Sweet Surrender* perfume have done their dirty work."

"You playing an electronic Cupid is something I've got to see," Carl announced. "Reserve me a seat up in your room to-

. . . Norma ran down the porch steps as Bosco pawed gingerly at his ears . . .

night. I'll be over right after that 9:30 shoot-em-up TV program."

He was as good as his word, and the two boys squatted on the floor by the window of the hot, darkened bedroom for almost an hour before they heard the picket gate of the house next door click open and shut, and caught sight of two figures walking onto the vine-hung front porch. Jerry already had the amplifier warmed up; and as he heard the rhythmic squeaking of the porch swing chains, he flipped on the oscillator that had been preset to the ultrasonic frequency. The shift in the fluorescent blue glow on the glass envelopes of the amplifier output tubes indicated that they were delivering power. No sound was heard from the speaker, however, and there was no halt in the rhythmic squeaking of the swing chains.

"Well, at least Melvin can't hear the sound," Jerry whispered hoarsely as he stared down at the darkened porch. Just

(*Continued on page* 123)

AFTER CLASS

THE STORY OF RESONANCE

IF THE electrical effect called resonance should suddenly cease to exist, every radio and television set in the world would stop functioning — instantly, completely, and utterly! For in every piece of high frequency gear, there is at least one—and generally more than one—resonant circuit without which the equipment simply could not perform.

Resonance, discovered in relation to sounding bodies long before Alexander Volta fabricated his first electric battery, means the "intensification of sound by sympathetic vibration." The same term in electricity refers to a similar phenomenon in capacitor-inductor combinations in which a.c. may be intensified by a kind of "resounding" effect between the capacitor and the coil. Resonant circuits provide *tuning* in radio and TV sets (the ability to *select* one frequency from many), *trapping* in electronic circuits (the ability to *reject* one frequency among many), and, finally, *increasing gain* in these circuits.

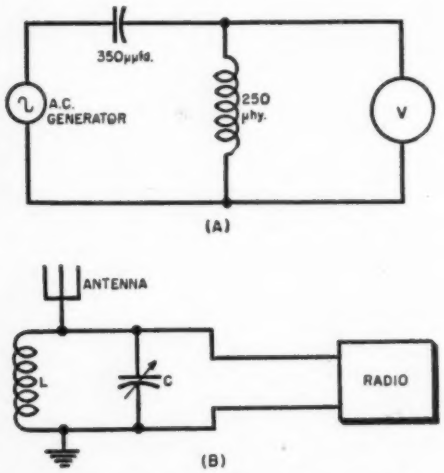


Fig. 1. (A) Effects of resonance on voltmeter reading. (B) Resonance used in tuning a radio.

The common variety of resonant circuit consists of a coil and a capacitor connected in either series or parallel with some kind of a.c. generator. In technical parlance, resonance occurs at the frequency at which the reactance of the coil is equal to the reactance of the capacitor. Practically everything that happens in resonance can be explained by one effect: a very large voltage can be developed across the coil or capacitor by a relatively small voltage *of the right frequency* from the generator.

Consider the circuit in Fig. 1A. Assume that the a.c. generator is variable and can provide frequencies from 100 kc. to 1000 kc. Starting at the low end—at 100 kc. —we slowly raise the frequency while keeping the voltmeter *V* under observation. At the beginning, nothing happens. As the frequency goes up, the voltmeter begins to show an increasing reading. When the frequency becomes exactly 538 kc., it reads quite high. Then, on the other side of 538 kc., the voltmeter begins to fall off in its indication, dropping to zero at 1000 kc. This particular combination of *L* and *C* (250 microhenrys and 350 micromicrofarads) is resonant at precisely 538 kc. At this frequency, the voltage which appears across either the coil or capacitor is maximum.

Let us see how this phenomenon is used in tuning in a radio or a TV station (*selection*). A resonant circuit consisting of *L* and *C* (Fig. 1B) is connected between an antenna and ground, with the input of a radio connected across the combination as shown. Waves of many different frequencies cut across the antenna, inducing various voltages in the circuit; these voltages cause currents to flow from the antenna to ground through the *LC* combination, but only one of them—the frequency to which *L* and *C* resonate—can produce a sufficiently large voltage to make the radio perform. If the setting of *C* is now changed (*C* is a variable capacitor as indicated by the arrow through it), the circuit changes its resonant frequency and another of the intercepted waves is able to generate enough potential to feed a usable signal to the radio set. Thus, the station selected by the resonant circuit is determined by the relationship of the inductance of coil *L* and the capacitance of *C*.

A similar combination used in the arrangement which is shown in Fig. 2A serves as a *rejection* circuit, or *trap*. This

is an arrangement that prevents one particular frequency from getting to the radio or TV set. *L2* and *C2* form the selection circuit, just as in Fig. 1B. *L1* and *C1* are tuned to the undesired frequency. As the many induced currents from passing waves attempt to flow down through the coils and capacitors, the one to which *L1* and *C1* are tuned causes a large voltage to appear across this particular pair. But only a limited potential is available from the antenna, and when so much of it appears across *L1* and *C1*, there is nothing left for

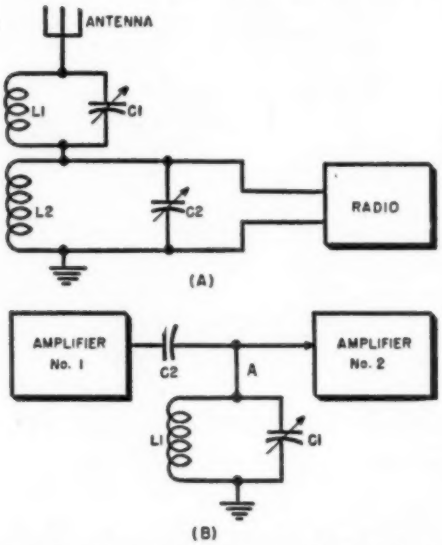


Fig. 2. (A) Resonant trap or rejection circuit. (B) How gain is increased by resonant circuit.

the *L2-C2* combination that feeds the radio. Hence, the frequency to which *L1-C1* is tuned is "trapped out" by making it develop its voltage where it will do no harm.

The manner in which resonant circuits help to increment voltage gain is best seen, perhaps, in circuits like that of Fig. 2B. Two radio-frequency amplifiers are to be coupled to each other to form a "cascaded" pair; the intent, obviously, is to get as much voltage amplification as possible. The tubes provide a large measure of this gain but the resonant circuits augment tube action to an enormous extent. The signal voltage from amplifier #1 is transferred to the resonant circuit comprising *L1* and *C1* through coupling capacitor *C2* which, by the way, plays no part in the action. This voltage starts a resonant current flowing in the *L1-C1* pair, thus developing a large voltage between point "A" and ground. Since the input of amplifier #2 is connected to point "A," the voltage it receives is much greater than it would have been if the resonant circuit had been omitted. Capacitor *C2* serves only to keep the d.c. voltages in amplifier #1 from affecting the second amplifier.

We have discussed only the more popular parallel resonant circuits in these applications. They are sometimes referred to as "anti-resonant" hookups. Series resonance is applied somewhat differently but performs in very much the same manner.

The following quiz is intended as a self check. You should be able to answer all of the questions correctly if you have mastered the text. Answers are on page 127.

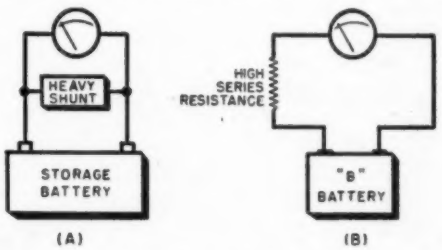
QUIZ

1. **How many different frequencies can produce the condition of resonance or anti-resonance in a given LC combination?**
2. **Is a resonant trap usually considered a rejection or a selection type of circuit?**
3. **Does a parallel resonant circuit develop a large or a small voltage drop across itself for the resonant frequency?**
4. **If a parallel resonant circuit is placed in series with a second tuned circuit, does it select or reject the frequency to which it is resonant?**
5. **If the voltage fed to a radio from a tuned antenna circuit is taken in parallel with an anti-resonant circuit, as in Fig. 2A, does the anti-resonant circuit constitute a trap or a selection circuit?**

BATTERY TESTING

IF A STORAGE BATTERY were to be tested with the kind of voltmeter used for checking the condition of radio "B" batteries, the reading obtained would be entirely meaningless and unreliable; on the other hand, attempting to check a "B" battery by means of a storage battery voltmeter would quickly ruin the "B" battery!

The fundamental difference between these two voltmeters is the *load* or *drain* placed on the battery during measurement by the instrument itself. Unless a storage battery can maintain its output voltage at about 2 volts per cell (6 volts total for

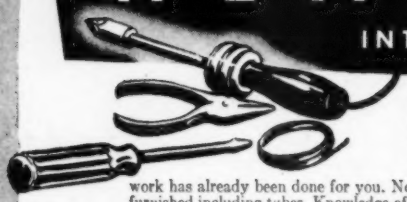


most of the standard types having three cells in series; 12 volts for batteries found in new cars) under a short-period drain of 300 amperes or more, it cannot be depended upon to start the engine, especially under the conditions imposed upon it in freezing weather. To check a battery under such a condition, an instrument like

(*Continued on page* 104)

Build YOUR OWN HEATHKITS

INTERESTING—EDUCATIONAL



Heathkits are fun to build with the simplified easy-to-follow Construction Manual furnished with every kit. Only basic tools are required, such as soldering iron, long-nosed pliers, diagonal cutting pliers, and screwdriver. All sheet metal work has already been done for you. No cutting, drilling, or painting required. All parts furnished including tubes. Knowledge of electronics, circuits, etc., not required to successfully build Heathkits.

New PRINTED CIRCUIT VACUUM TUBE VOLTMETER KIT

New charcoal gray baked enamel panel with highly readable white lettering.

New peak-to-peak meter scale—new color harmony—new control knobs.

New printed circuit board for faster, easier construction—exact duplication of Laboratory development model.

The VTVM is the standard basic voltage measuring instrument for radio and TV servicemen, engineers, laboratory technicians, experimenters, and hobbyists. Because of its extremely high input resistance (11 megohms) the loading effect on the circuit being measured, is virtually negligible. The entire instrument is easy to build from a complete kit, with a detailed step-by-step Construction Manual. Featured in this instrument is an easy-to-wire foolproof printed circuit board which cuts assembly time in half

CIRCUIT AND RANGES: Full wave AC input rectifier permits 7 peak-to-peak voltage ranges with upper limits of 4000 volts peak-to-peak. Just the ticket for you TV servicemen. Seven voltage ranges, 1.5, 5, 15, 50, 150, 500 and 1500 volts DC and AC RMS. Peak-to-peak ranges 4, 14, 40, 140, 400, 1400, and 4000 volts. Ohmmeter ranges X1, X10, X100, X1000, X10K, X100K, X1 meg. Additional features are a db scale, center scale zero position, and a polarity reversal switch.

IMPORTANT DESIGN FEATURES: Transformer operated—1% precision resistors—6AL5 and 12AU7 tubes—selenium power rectifier—individual AC and DC calibrations smoother improved zero adjust control action—new panel styling and color—new placement of pilot light—new positive contact battery mounting—new knobs—test leads included. Easily the best buy in kit instruments.

Model V-7

$24.50

Shpg. Wt. 7 lbs.

New easy-to-read open panel layout. Off-on switch incorporated in selector switch

Heathkit HANDITESTER KIT

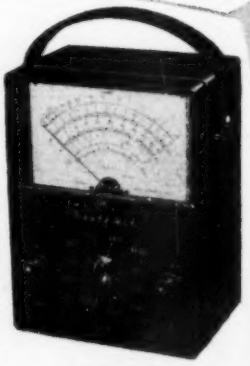
The Heathkit Model M-1 Handitester readily fulfills all requirements for a compact, portable volt-ohm-milliammeter. Its small size permits the instrument to be tucked into your coat pocket, tool box or glove compartment of your car. Always the "handitester" for those simple repair jobs. Packed with every desirable feature required in an instrument of this type. AC or DC voltage ranges, full scale 10, 30, 300, 1000 and 5000 volts. Ohmmeter ranges 0–3000 ohms and 0–300,000 ohms. DC milliammeter ranges 0–10 milliamperes and 0–100 milliamperes. Uses 400 microampere meter—1% precision resistors—hearing aid type ohms adjust control—high quality Bradley rectifier. Test leads are included.

MODEL M-1

$14.50

Shpg. Wt. 3 lbs.

Heathkit MULTIMETER KIT



Here is an instrument packed with every desirable service feature and all of the measurement ranges you need or want. High sensitivity 20,000 ohms per volt DC, 5000 ohms per volt AC. Has the advantage of complete portability through freedom from AC line—provides service ranges of direct current measurements from 150 microamperes up to 15 amperes—can be safely operated in RF fields without impairing accuracy of measurement.

Full scale AC and DC voltage ranges of 1.5, 5, 50, 150, 500, 1500, and 5000 volts. Direct current ranges are 150 microamperes, 15, 150, and 500 milliamperes and 15 amperes. Resistances are measured from .2 ohms to 20 megohms in three ranges and db range from −10 to +65 db. Ohmmeter batteries and necessary test leads are furnished with the kit.

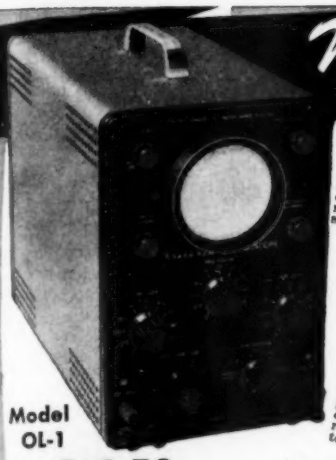
MODEL MM-1

$29.50 Shpg. Wt. 6 lbs.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 10, MICHIGAN



New PRINTED CIRCUIT

Heathkit 3" OSCILLOSCOPE KIT

Ideal for individual home workshop, ham shack, or as extra instrument for outside servicing.

Compact size, light weight, portable — perfect for service work or field operation.

New, modern styling, gray panel with white lettering, light gray knobs and case — contrasting red and black terminal posts.

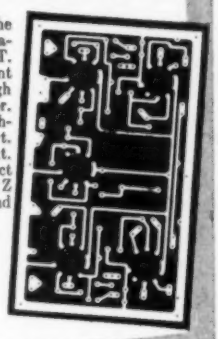
New printed circuit for constant circuit performance, rugged component mounting — assembly time cut in half!

Model OL-1

$29.50 Shpg. Wt. 15 lbs.

USE: This brand new Utility Scope was designed especially for servicemen and radio amateurs, and is adaptable for use in all general Scope applications. Perfect for modulation monitoring, etc. Use it to tackle alignment or adjustment problems. Equally valuable in breadboard work. A must for ham shack or for outside servicing.

DESCRIPTION: Front panel controls of the Model OL-1 are "bench tested" for ease of operation and convenience. Sharp focusing 3" CRT. Printed circuit for ease of assembly and constant performance. Assembly time cut in half! High quality electronic components used. Sensitive hor. and vert. amplifiers with broad freq. response; cathode follower for isolation. Push-pull hor. and vert. output to deflection plates. Int ., 60 cycle, or ext. sync. Sweep freq. range 10–100,000 cycles. Direct connection to deflection plates. Provision for Z axis input. Uses 3GP1 CRT, 4–12AU7 hor. and vert. amplifiers, 1–12AX7 sweep gen., 1–6X4 LV rect., and 1–1V2 HV rect. The Heathkit Model OL-1 is a real standout value at only $29.50, and is another example of the famous Heathkit combination: quality plus economy.



Measures only 11¾" x 6¾" x 19½" and weighs only 11 pounds.

Heathkit SIGNAL GENERATOR KIT

New, modern panel and knob styling — professional appearance and professional performance.

Broad frequency coverage — fundamentals from 160 KC to 110 MC in 5 bands — up to 220 MC on calibrated harmonics.

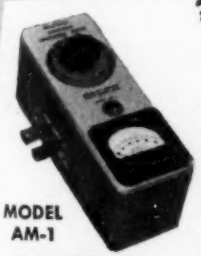
Cathode follower output for good isolation — fixed step and continuously variable attenuation.

Output selection — internal modulation, pure r.f., or audio output.

USE: This instrument is "serviceman engineered" to fill the requirement for a reliable basic service instrument at moderate cost. Frequency coverage extends in five bands from 160 Kc to 110 Mc on fundamentals, and dial is calibrated to 220 Mc for harmonics. Pre-wound and pre-aligned coils make calibration unnecessary for service applications.

DESCRIPTION: The Heathkit Model SG-8 Signal Generator provides a stable modulated or unmodulated RF output of at least 100,000 microvolts which can be controlled by both a continuously variable and a fixed step attenuator. Internal modulation is at 400 cycles, or can be externally modulated. AF output of 2-3 volts is also available for audio testing. Uses dual purpose 12AU7 as Colpitts RF oscillator and cathode follower for stable, isolated, low impedance output, and type 6C4 tube for 400 cycle oscillator. Operation of the SG-8 is well within the frequency limits normally required for service work. Modern styling features high definition white letters on charcoal gray panel with re-designed control knobs. Modern professional appearance and Heathkit engineering know-how combine to place this instrument in the "best buy" category. Only $19.50 complete.

MODEL SG-8 **$19.50** Shpg. Wt. 8 lbs.



MODEL AM-1

$14.50 Shpg. Wt. 2 lbs.

Heathkit ANTENNA IMPEDANCE METER KIT

The Model AM-1 Antenna Impedance Meter makes an ideal companion unit for the GD-1B Grid Dip Meter or a valuable instrument in its own right. Perfect for checking antenna and receiver impedance and match for optimum system operation. Use on transmission lines, halfwave, folded dipole, or beam antennas. Will double as monitor or relative field strength meter. Covers freq. range of 0–150 Mc and impedance range of 0–600 ohms. Uses 100 microampere meter and special calibrated potentiometer. A real buy at only $14.50 complete.

Heathkit GRID DIP METER KIT

MODEL GD-1B

$19.50 Shpg. Wt. 4 lbs.

Amateurs and servicemen have proven the value of this grid dip meter many times over. Indispensable for locating parasitics, neutralizing, and aligning filters and traps in TV or Radio and for interference problems. The Model GD-1B covers from 2 Mc to 250 Mc with 5 pre-wound coils. Featuring a sensitive 500 microampere meter and phone jack, the GD-1B uses a 6AF4 or 6T4 tube. An essential tool for the ham or serviceman.

ACCESSORIES: Low freq. coverage to 355 KC with two extra coils and calibration curve. Set No. 341A for GD-1B and set No. 341 for GD-1A. Shipping weight 1 lb. Only $3.00.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 10, MICHIGAN

New Heathkit VFO KIT

MODEL VF-1

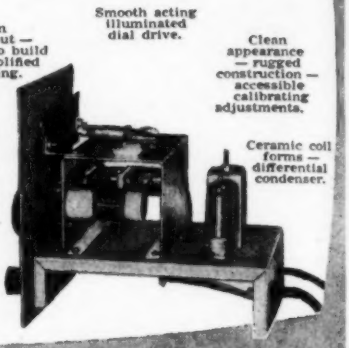
$19.50

Ship. Wt. 7 lbs.

- Smooth acting illuminated and precalibrated dial.
- 6AU6 electron coupled Clapp oscillator and OA2 voltage regulator.
- 7 Band coverage, 160 through 10 meters—10 Volt RF output.
- Copper plated chassis—aluminum cabinet—easy to build—direct keying.

Here is the new Heathkit VFO you have been waiting for. The perfect companion to the Heathkit Model AT-1 Transmitter. It has sufficient output to drive any multi-stage transmitter of modern design. A terrific combination of outstanding features at a low kit price. Good mechanical and electrical design insures operating stability. Coils are wound on heavy duty ceramic forms, using Litz or double cellulose wire coated with polystyrene cement. Variable capacitor is of differential type construction, especially designed for maximum bandspread and features ceramic insulation and double bearings.

This kit is furnished with a carefully precalibrated dial which provides well over two feet of calibrated dial scale. Smooth acting vernier reduction drive insures easy tuning and zero beating. Power requirements 6.3 volts AC at .45 amperes and 250 volts DC at 15 mills. Just plug it into the power receptacle provided on the rear of the AT-1 Transmitter Kit. The VFO coaxial output cable terminates in plastic plug to fit standard ¼" crystal holder. Construction is simple and wiring is easy.


Open layout — easy to build — simplified wiring.
Smooth acting illuminated dial drive.
Clean appearance — rugged construction — accessible calibrating adjustments.
Copper plated chassis—careful shielding.
Ceramic coil forms — differential condenser.

Heathkit AMATEUR TRANSMITTER KIT

MODEL AT-1

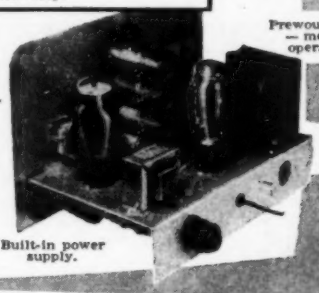
$29.50

Ship. Wt. 16 lbs.

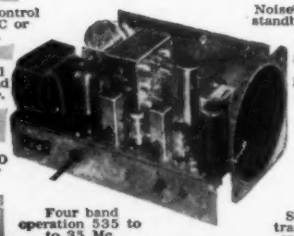
SPECIFICATIONS:

Range 80, 40, 20, 15, 11, 10 meters.
6AG7 .....Oscillator-multiplier.
6L6 .....Amplifier-doubler
5U4G .....Rectifier.
105-125 Volt A.C. 50-60 cycles 100 watts. Size: 8⅛ inch high x 13⅛ inch wide x 7 inch deep.

Here is a major Heathkit addition to the Ham radio field, the AT-1 Transmitter Kit, incorporaring many desirable design features at the lowest possible dollar-per-watts price. Panel mounted crystal socket, stand-by switch, key click filter, A. C. line filtering, good shielding, etc. VFO or crystal excitation—up to 35 watts input. Built-in power supply provides 425 volts at 100 MA. Amazingly low kit price includes all circuit components, tubes, cabinet, punched chassis, and detailed construction manual.

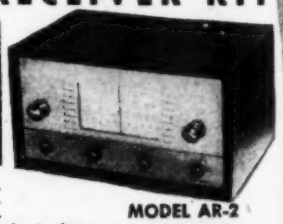


Heathkit COMMUNICATIONS RECEIVER KIT


RF gain control with AVC or MVC.
Noise limiter—standby switch.
Electrical bandspread and scale.
½ inch PM Speaker-Headphone Jack.
Stable BFO oscillator circuit.
Four band operation 535 to to 35 Mc.
Six tube transformer operation.

SPECIFICATIONS:

Range.....535 Kc to 35 Mc
12BE6 .....Mixer-oscillator
12BA6 .....I. F. Amplifier
12AV6 Detector—AVC—audio
12BA6 ....B. F. O. oscillator
12A6.....Beam power output
5Y3GT .....Rectifier
105-125 volts A. C. 50-60 cycles, 45 watts.



A new Heathkit AR-2 communications receiver. The ideal companion piece for the AT-1 Transmitter. Electrical bandspread scale for tuning and logging convenience. High gain miniature tubes and IF transformers for high sensitivity and good signal to noise ratio. Construct your own Communications Receiver at a very substantial saving. Supplied with all tubes, punched and formed sheet metal parts, speaker, circuit components, and detailed step-by-step construction manual.

MODEL AR-2

$25.50

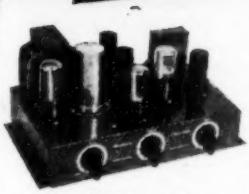
Ship. Wt. 12 lbs.

CABINET:

Proxylin impregnated fabric covered plywood cabinet. Shipg. weight 5 lbs. Number 91-10, $4.50.

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM, INC.
BENTON HARBOR 10, MICHIGAN

Heathkit ECONOMY SIX-WATT AMPLIFIER KIT



MODEL A-7B

$15.50 • Shpg. Wt. 10 lbs.

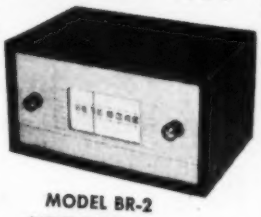
Here is an outstanding amplifier value. This economically priced amplifier is capable of performance usually associated only with far more expensive units. Can be nicely used as the heart of an inexpensive high quality home music system. Features inputs for tuner and phono (Model A-7C accommodates a microphone by using an additional preamplifier stage). Separate bass and treble boost and cut tone controls for just the degree of tonal balance you want. The entire kit can be built in a few pleasant hours for years of enjoyment.

Technical features, frequency response ± 1½ db 20–20,000 cycles. Full 6 watts output. Push-pull beam power output stage. Output transformer impedances 4, 8, and 15 ohms. Tube lineup, 12J5GT, 12SL7, 2—12A6, 5Y3GT, and 12SJ7 (A-7C only).

All parts including tubes are supplied along with a prefabricated and painted chassis. Detailed step-by-step Construction Manual eliminates necessity for specialized knowledge.

MODEL A-7C incorporates a preamplifier stage with special compensated network to provide necessary gain for operation with variable reluctance cartridge or microphone. **$17.50**

NEW Heathkit BROADCAST BAND RECEIVER KIT



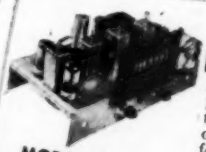
MODEL BR-2

$17.50 • Shpg. Wt. 10 lbs.

less Cabinet

Here is the ideal radio kit for the student, beginner, or hobbyist. If you have ever had the urge to build your own radio receiver, this kit deserves your attention. Circuit is transformer operated, eliminating shock hazard usually associated with "economy" AC-DC circuits. New high gain miniature tubes and IF transformers—powerful ferrite core built-in rod type antenna—chassis mounted 5½" PM speaker—optional operation either as receiver or tuner and phono input. Covers broadcast band 550—1600 Kc. Uses 12BE6, 12BA6, 12AV6, 12A6, and 5Y3 tubes.

CABINET: Proxylin impregnated fabric covered plywood cabinet available. Includes aluminum panel, flocked re-inforced speaker grill and protective rubber feet. 91-9, Shpg. Wt. 5 lbs. **$4.50**



MODEL FM-2

$22.50 • Shpg. Wt. 8 lbs.

Heathkit FM TUNER KIT

Here is an FM tuner kit designed for simplified construction to operate either through the "phono" section of your radio or with a separate amplifier. AC transformer operated—8 tube circuit—slide rule type tuning dial—88–108 megacycle coverage—three double tuned IF stages—factory adjusted front end. Experience the thrill of building your own FM tuner and at the same time enjoy all of the advantages of true FM reception.

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ON PARCEL POST ORDERS insure postage for weight shown.

ORDERS FROM CANADA and APO's must include full remittance.

Short-Wave Bands

(*Continued from page* 65)

LUXEMBOURG — *Radio Luxembourg,* 6090 kc., Junglinster, is heard regularly with programs and commercials in English from 1600 to 1905 s/off. The final announcement in Flemish is the only part not in English. It features quite a few disc jockey programs. This station is also heard well at 0030-0145. (*West, N. J.; Mackajewski, Sr., N. Y.*)

MOZAMBIQUE—The *Radio Clube de Mozambique* on 4920 kc. has an English request program and commercials that can be heard at 2309-2320. Some c.w. QRM at times will make this a rough one to log.

NETHERLANDS—*Radio Nederland* is now on the summer schedule as follows: to South Asia and Africa at 1045-1125 on 17800, 17775, 15425, and 15220 kc., and alternative on 11950 and 11730 kc.; to Europe and North America at 1645-1725 on 11950, 11730, 9745, 9590, and alternative 6025 and 5980 kc.; to North America, Australia, and New Zealand from 2130 to 2210 on 9745, 9590, 6025, 5980, and alternative 11950 and 11730 kc. (*Buettner, Germany*)

NIGERIA—The *Nigerian Broadcasting Service* at Lagos on 4800 kc. signs off at 1700 daily and at 1710 on Sunday. It has records until 1700, identifies, and signs off with *"God Save The Queen."* (*West, N. J.*)

PORTUGAL—At present the following s.w. stations are operating: (1) *Emisorra Nacional,* Lisbon—to the USA at 1915-2130 on 9750 and 5960 kc.; to Macau and Timor at 0600-0800 on 15050 and 11996 kc.; to Portuguese India at 0815-1200 on 15050 and 11996 kc.; to Sao Tome, Principe, Angola, and Mozambique at 1230-1530 on 11996 and 9775 kc.; to Portuguese Guinea, Cape Verde Islands, and Brazil at 1600-1900 on 11915 and 9775 kc.; to Azores and Madeira Islands at 0700-1000 on 11915 kc. relaying medium-waves, at 1300-1900 on 6374 kc. relaying medium-waves; (2) *Radio Renascenca,* Lisbon, a Catholic station, operates from 0330 to 0530, 0700-1000, 1330-1900 on 6154 kc.; (3) *Radio Clube Portugues,* Parede (near Lisbon) operates at 0200-1000, 1330-2000 on 6080 kc. relaying medium-waves. (*Sousa, CTØ83, Portugal*)

SPAIN—A new frequency for *Radio Nacional de Espana,* Madrid, is 7090 kc., heard at 1600 in parallel with 9360; the 9360 channel is heard very well from the USA at 1800-1840 in English. The Spanish Clandestine station (Spanish Communist Party in Exile) is being noted on 8070 and 6965 kc. from 1620 to 1800; the 8070-kc. channel is sometimes QRM'ed by a facsimile transmitter at Dorval, Quebec.

THAILAND—*Radio Thailand,* according to a letter just received, operates as follows: home service at 1900-2000, 0700-1020 on 6240, 7140, 11910, and 15640 kc.; overseas service for Thai Forces in Korea is at 0430-0520 with news in Thai at 0435-0450; general overseas service is scheduled for 0525-0657 with news in English at 0530-0545; home service relay is at 0800-0900; North American service operates at 2315-0015 with English news at 2325-2340. The overseas services are radiated on 11670 kc., HSK9, 50 kw.

USSR—*James Hart, N. J.,* wrote to Moscow explaining how the Voice of America and Canadian stations verify reports from any of their stations throughout the world, and asked them to do likewise as it is such a large country with so many stations. Many DX'ers would like to be able to get veries from some of the lesser known stations, thereby getting veries from new zones. The reply from Moscow was as follows: "We are sorry to inform you that we do not verify programs from local stations. We confirm only reception of programs in the English language transmitted from Radio Moscow to North America." It was signed by I. Petrov. That just about eliminates the possibility of getting veries from Kharborovsk, Komsomolsk, and other stations.

SHORT-WAVE RECEPTION is definitely on the upgrade. Recent observations indicate that the sunspot cycle is once again rising and s.w. reception is becoming increasingly better. Now is a good time for many of the older, inactive DX'ers to dust off the receiver and try their hand at tuning. Results *could* be amazing. A person does not have to be a night-owl to get the good DX, either. One of our most active reporters is always in bed by just after midnight.

Late Items

PERU—OAX8C, 9523 kc., *Radio Nacional de Iquitos,* Iquitos, Peru, is being heard on this new channel at 1900-2200. OBX4C, 15197 kc., *Radio El Sol,* at Lima, is being heard at 0700-2200; at first on 15199, it has now settled on 15197. OAX6E, *Radio Continental,* Arequipa, is being heard on 6308 at 1900-0000. OBX4Q, *Radio El Sol,* Lima, is testing its new 10-kw. xmtr. and asking for reports to Box 1711; the tests currently are made Wednesdays and Saturdays at 2215-0100 but are usually not audible until HI4T signs off at midnight.

VENEZUELA—YVQN, Puerto La Cruz, has moved from 3380 to 3335; YVQN was noted at 1900-2230. YVQG, Carupano, has moved from 3320 to 3325; noted 1900-2130.

That's it for this month, gang. Please keep the reports coming! —30—

Geiger Counter Survey

(*Continued from page 27*)

"Professional" Model 107—$139.50 (*Precision Radiation Instruments*). Weighing about 6 pounds, this unit has a 900-volt Geiger tube attached to a 3-foot cable. The probe includes a shield to discriminate between beta and gamma radiation, and the case is waterproofed and tropicalized. There are three means of indicating radioactivity: neon flashing bulb, headphone and meter. The meter is scaled from 0.0 to 0.2, 2.0 and 20.0 mr/hr. Model 107 has a calibration control on the panel which enables field checks without additional equipment. It uses two small 45-volt batteries, one 22½-volt hearing-aid type battery and two flashlight cells; according to the manufacturer, they will "last for months" under normal usage. The "Professional" is sold complete with calibrating sample, batteries, headphone and instructions.

"Radiation Detector" Model RD-86—$140.00 (*Micro Specialties Co.*). Claimed by the manufacturer to be one of the smallest and lightest Geiger counters available, the "Radiation Detector" measures 3¾" x 2½" x 6¼" and weighs just about 2¼ pounds; this does not include the external probe and leather carrying case. The basic unit is housed in a Bakelite case and incorporates the meter (three-range sensitivity), battery test circuits, flashing neon lamp, and two-tube amplifier circuit. Battery life is claimed by the manufacturer to be about 150 hours under normal field use. Model RD-86 requires one 6-volt and three 30-volt batteries. The probe is chrome-plated and may be purchased with a 16" extension. This unit is sold without earphone, but with batteries, tubes, etc.

"Colorado" Model 200—$149.50 (*Goldak Co.*). An external probe instrument (4-foot cable), the "Colorado" weighs just under 5½ pounds. It measures 3¾" x 7⅞" x 4¾" and is built into a gray hammertone aluminum case. Power is derived from two 45-volt batteries and two flashlight cells. The circuit is voltage-regulated and mechanically rugged; it utilizes printed circuits and is dip-soldered. Neon flasher, headphones or the three-scale meter may be used as indicator. The scales run from 0.0 to 0.2, 2.0 and 20.0 mr/hr. Model 200 is sold complete with an ore sample and calibration chart, headphones, shoulder carrying strap and complete instructions.

"Ore-Lokator" Model RM2N—$149.50 (*Nucleonic Co. of America*). Model RM2N weighs about 7½ pounds and has a plug-in type Geiger tube mounted in a chrome-plated probe with 3½ feet of cable. The

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Miniature Storage Battery—Vitamite—2.2v wet cell 1¾x½x¼ New-Dry charged. **99¢ ea.**

Western Electric Stepper Switch—6 or 12 V. D.C. 44 steps in model railroad application will show switch-blocks and operate signals as loco rides—Worth over $30.00. **Special $7.95**

Resonant Cavity UHF assembly—with fitting—Brand New Type. **$1.49 ea.**

Pocket Battery Tester—"King Sol" Worth $8.00 ea. Brand New, boxed instr. sheet. Precision designed ammeter will accept batteries and give actual dynamic indication of condition. **$1.49 ea.—4 for $5.00**

STANCOR choke—C1710—7 Henry—150MA—Unused—Shelf worn—Reg. $4.95—Special. **$1.00—6 for $5.00**

Hearing Aid Subminiature tubes, unbranded. **5 for $1.00**

Buzzer-type Z2—115V 60 Cy. Removed fr. unused equip. **$1.00**

Code Trainer—this device will provide an audible sound or blinking light for code training purposes. B/New complete w/instr.—as used by USN. Wt. 1 lb. **$2.49**

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case is watertight (and tropicalized) hammertone blue aluminum. Sensitivity is claimed to be 0.02 mr/hr, which is roughly down to a concentration of 0.003% uranium. The "Ore-Lokator" is metered and calibrated from 0.0 to 0.25, 2.5 and 25 mr/hr. and battery life is rated at 400 hours. There is single-switch control for all meter scales, plus a position to check voltage applied to the Geiger tube. A neon panel light is provided to indicate when the unit is in operation, and headphone may be attached. Model RM2N is sold with a radioactive calibrating source, headphone, batteries, sample pans and instruction booklet.

"Model GS-3"—$149.50 (*Nuclear Measurements*). This is a rugged unit originally designed to military specifications. It weighs 4¼ pounds and measures 7" x 3½" x 3". Model GS-3 uses three miniature "B" batteries and two small "D" cells, having a replacement cost of $6.30. Life expectancy is over 300 hours of intermittent use for the "D" cells and 600 hours for the "B" batteries. Metered for 0-500, 0-5000, and 0-50,000 counts per minute, it uses a special relaxation-type oscillator for high-voltage generation. The manufacturer particularly stresses compact, rugged construction; tests show no damage after a 5' fall on concrete. The unit is sold with a probe that may be readily disassembled for cleaning. Purchase price includes strap for carrying, single headphone, etc.

"Military Type" Model PR-6—$159.50 (*El-Tronics*). A rugged Geiger counter originally intended to meet specific military service requirements is the *El-Tronics* Model PR-6. The manufacturer has designed the circuit to afford battery life in the hundreds of hours for normal field survey use. Metered with three scales ranging from 0.2 mr/hr. to 2.0 and 20.0 mr/hr., Model PR-6 uses two 67½-volt "B" batteries and one 1½-volt flashlight cell. It is waterproof and tropicalized in a hammertone case measuring 5⅛" x 8¼" x 5¼". An external probe slips into the case housing so that it will not be damaged when in the field. This unit is shipped complete with batteries, instructions, earphones, etc.

"Model F-6"—$159.50. (*Technical Associates*). There are several unusual features to this unit, including a loudspeaker in place of the earphones, an extra-long cord (5-foot) on the probe, and a sensitive metering system reading 500 to 5000 counts per minute. Model F-6 is built into a hammertone finish aluminum case. The complete instrument weighs 7¼ pounds and measures 10" x 4⅜" x 5⅝". Battery life is

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THE H & R PERPETUAL CATALOG

Are you aware of the latest devices in electronics and industry? When on our mailing list, you will receive our Monthly Bulletins featuring outstanding values in: Timers, Relays, Switches, Motors, Blowers, Meters, and a wide and varied selection of fine electronic equipment. The next 12 issues can be yours for just 25¢. Included in the current bulletins are:

RADIOSONDE TRANSMITTER

S.C. Type T49B/AMTI. Complete X-mitter with 3A5 tube, less batteries. Parts contained ideal for model control applications. . . . . No. P4266 **$3.95** 10 For **$35.00**

PELORUS COMPASS DIAL

7½" dia. White translucent compass dial calibrated 0-360°. May be edge or back illuminated. . . . . No. P2880 **$1.50**

GATTY WORLD & STAR MAP

Combination world and star chart for finding latitude & longitude by the stars. With complete instructions; Size 44 x 22". . . . . No. P4202 **$1.00** Per Dozen **$10.00**

SANGAMO WATTHOUR METERS

Like new. Rated 5 A. @ 115 V., 60 cy. With glass cover, Metal Base. . . . . No. P4512 **$4.95** Six For **$27.00**

60 MINUTE TIMER

Strikes a bell at end of present time. Mounted on chrome panel. Large easy-to-set knob. Size: 4⅜ W. x 2¾ H. x 1⅜" D. . . . . No. P4273X **$1.95** 10 For **$17.50**

BLACK LIGHT KITS

Includes 4 W. bulb, ballast, starter, starter socket, lamp mounting, switch, line cord & plug, and schematic. . . . . No. P4517 **$2.50** 10 For **$22.50**

Same as above, except with 8 W. bulb. . . . . No. P4519 **$2.95** 10 For **$26.00**

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For the "Do-It-Yourself" enthusiasts—a complete kit including everything required for complete home sanitation. Kit consists of: 8 W. germicidal lamp, pair of lamp mtg. brackets, ballast, starter, starter socket, switch & line cord, and plug. Operates on 110-120 V. 60 cy. Instructions included are easy to follow. . . . . No. P4521 **$8.95** 10 Kits For **$80.00**

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PROFESSIONAL GEIGER COUNTER KIT

MODEL GCK-1

Designed and executed by experts in radiation counter field. All internal and external metal work completed and beautifully finished. Eyeletted phenolic card for easy circuit hook-up. Highest quality meter with special scale calibrated in counts per minute. Three range sensitivity switch. Includes headphones and carrying strap. Makes a counter equal to many in the $150 class.

$59.50, *less batteries.*

Send for Complete Data.

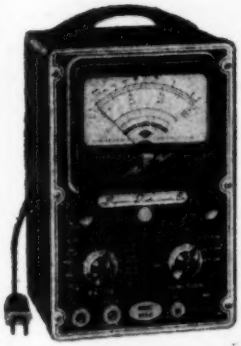
GRAHAM ELECTRONICS SUPPLY, INC.
102 South Pennsylvania Street **Indianapolis, Indiana**

claimed by the manufacturer to be about 200 hours under normal field conditions. The meter has been especially selected for visibility and may be easily read at arm's length. A built-in battery-checking circuit enables the operator to ascertain battery condition in the field. Model F-6 is sold complete with batteries, instructions, calibration source, carrying strap and AEC booklets.

"Survey Meter" Model SM-5A—$185.00 (*Nuclear Research Corp.*). Although designed for military requirements, this unit has found some favor in uranium prospecting. It measures 4¾" x 4⅞" x 8⅞" and weighs just under 6 pounds. Model SM-5A uses a probe with a sliding shield for beta discrimination. It is metered with three scales ranging from 0.5 to 5.0 and 50.0 mr/hr on a 50-microampere meter. Battery life is claimed by the manufacturer to be 170 hours on the basis of an eight-hour-per-day operation. The unit is sold complete with earphones, carrying strap, calibration source and instruction manual.

"Thyac" Model 389C—$225.00 (*Victoreen Instrument Co.*). This unit was originally designed to meet certain military specifications. Built in a rugged heavy-duty case, it weighs 5⅞ pounds including the probe. The case is fiberglass reinforced plastic measuring 10" x 4¾" x 6¾". A 1B85 Geiger tube is used with this instrument. It is mounted in a probe attached to the case with a 4-foot self-coiling cable. Beta discrimination is possible with a shield surrounding the tube. Battery life is claimed by the manufacturer to be 110 hours at a rate of four hours use per day. Metered with ranges of 0.2, 2.0, and 20 mr/hr, it operates from a single mercury cell (1.3 volts) and a 4½-volt battery. The circuit is completely voltage-regulated and will maintain meter calibration while the batteries age. Model 389C is sold with plastic carrying strap, batteries, earphone and instruction book.

"Survey Meter" Model SU-14 — $225.00 (*Tracerlab*). This lightweight Geiger counter has a meter built in with calibrated ranges of 0.25, 2.5, and 25.0 mr/hr, plus counts-per-minute ranges of 500, 5000, and 50,000. The instrument measures 9⅛" x 3⅝" x 4¼" and is claimed by the manufacturer to be gasket-sealed for maximum waterproofing. Battery requirements include four flashlight cells and three 45-volt "B" batteries whose life is expected to be 150 hours of continuous operation. The probe is attached to the instrument with a 3-foot coiled retractile cable. Model SU-14 is sold complete with batteries, instruction manual, calibrated source, carrying strap, etc.



Superior's new Model 670-A

SUPER METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers.)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: −6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:
Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed, in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's new Model TV-11

TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron Miniatures, Sub-miniatures, Novals, Sub-miners, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because *all elements are numbered according to pin-number in the RMA base numbering system*, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus *It is impossible to damage a tube by inserting it in the wrong socket.*

★ Free-moving built-in roll chart provides complete data for all tubes.

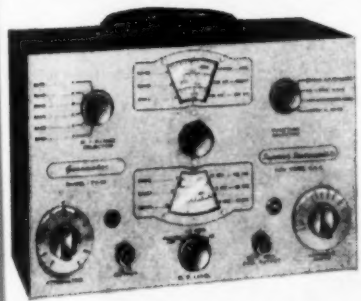
★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

This model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50 NET



THE NEW MODEL TV-50

GENOMETER

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing: A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

7 Signal Generators in One!

- R. F. Signal Generator for A.M.
- R. F. Signal Generator for F.M.
- Audio Frequency Generator
- Bar Generator
- Cross Hatch Generator
- Color Dot Pattern Generator
- Marker Generator

R. F. SIGNAL GENERATOR: The Model TV-50 Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 40 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV-50 projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

THE MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only ...

$47.50 NET

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Try any of the above instruments for 10 days before you buy. If completely satisfied *then* send down payment and pay balance as indicated on coupon. No Interest or Finance Charges Added! If not completely satisfied return unit to us, no explanation necessary.

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Dept D-144. 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

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Address.....

City..... Zone.... State.....

☐ Model 670-A Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.

☐ Model TV-11 Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TV-50 Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

precise MODEL G-1
"AD-ON" GEIGER COUNTER
REALLY SOUNDS OFF!

By a unique and exclusive "AD-ON" system, Precise makes available the most modern and ordinarily very expensive Geiger equipment at an amazingly low price. Here you start with as good a basic device as can be purchased and add to it as required—never throwing away your initial investment as your needs increase.

The Precise Model G-1 features these important "extras":

- ★ a transistorized audio system
- ★ a unique alarm signal arrangement that gives a long alert (even on a single radiation count)
- ★ an external Geiger tube probe and handle
- ★ a 67½ volt battery that is limited virtually only by its shelf life.

In addition, Precise makes available these additional "AD-ON" sections to increase the versatility of the Model G-1:

- ★ Model G-2 Meter Adapter—for visual meter indications in mr/hr
- ★ Model C-3 Ganged Geiger Tube Assembly—to multiply sensitivity 3 to 10 times for each section added
- ★ Model S-1 Scintillation Adapter

See them at your local jobber or write for details

PRECISE DEVELOPMENT CORP. • OCEANSIDE, N. Y.

• You can save time and money on electrical repairs with Trouble Tracker Jr. Check basic continuity of low-resistance power-off electrical circuits by simply touching Trouble Tracker Jr. to bothersome wiring. A flash of the built-in light pinpoints where your trouble lies.

See for yourself! Try Trouble Tracker Jr. at your neighborhood electrical store, write us for the name of your nearest dealer, or, for quick delivery, send your money to Dept. PE.

LA LINK AVIATION, INC
BINGHAMTON—NEW YORK

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

"Countmaster" — $250.00 (*Hoffman Radio Corp.*). One of the most versatile and unusual Geiger counters is the "Countmaster," which permits the prospector to make an immediate field assay of his uranium find. Besides being metered with ranges of 0.2 to 20.0 mr/hr, this instrument incorporates a timing device that controls four banks of neon lamps acting as a recorder. Counting range is up to 12,000 counts per minute. The "Countmaster" weighs 7¼ pounds, including the external probe. Figures on battery replacement and battery life were not available at this writing, but may be assumed to be within reasonable limits and comparable to other equipment.

"Thyac II" Model 646—$255.00 (*Victoreen Instrument Co.*). An improved version of the "Thyac" ($225.00), this Geiger counter particularly features six-range sensitivity starting at 500 counts per minute. (Using the 1B85 tube, a reading of 0.2 mr/hr is roughly equivalent to 800 counts per minute.) Also included in this circuit is an arrangement for four time constants from ½ to 10 seconds. There is a regulated vibrator high voltage supply, and battery replacement cost is claimed by the manufacturer to be about $1.50. The "Thyac II" can be usefully employed in laboratories as well as for uranium prospecting. Mechanically, this unit is rather similar to the "Thyac," having the same weight and battery requirements. It is also sold with a deep hole probe for $95.00 extra.

"Oracle" Model 2613—$325.00 (*Nuclear-Chicago*). This is probably the top-notch Geiger counter on the market today. Its sensitivity is such that changes of 0.001 mr/hr may be read on the built-in meter. This extraordinary sensitivity results from the use of a "pack" of ten G-M tubes mounted inside the unit. These tubes are specially matched and tested before shipment. The manufacturer claims that if one or more of the tubes go bad the instrument may be recalibrated in the field with only a very small loss of sensitivity. Metering is provided in three ranges starting at the low value of 0.02 mr/hr and going to 0.2 and 2.0 mr/hr full scale. Normal cosmic-ray background count is approximately half scale on the most sensitive meter scale. A special 900-volt stabilized audio oscillator high-voltage supply is used to excite the cluster of G-M tubes. Under normal field use, the batteries are claimed to last more than 250 hours; their replacement cost is about $7.00. A neon light on the panel of the instrument gives a visual indication in case of battery failure. The "Oracle" is shipped with a calibrated 0.1% uranium sample to enable field calibration and grid surveying. —30—

The following manufacturers of Geiger counters are represented in the "Market Survey" starting on page 21. Readers are urged to contact them for further information on any of the units described.

American Laboratories, Inc.
471 Clifton Ave.
Newark 4, N. J.

Barrett
22319 Kathryn Ave.
Torrance, Calif.

Detectron Corp.
5528 Vineland Ave.
North Hollywood, Calif.

EICO
84 Withers St.
Brooklyn 11, N. Y.

Electronic Applications, Inc.
5024 Lee Highway
Arlington 7, Va.

El-Mec Products, Inc.
10302 Franklin Ave.
Franklin Park, Ill.

El-Tronics, Inc.
Fifth and Noble Sts.
Philadelphia 23, Pa.

Fisher Research Laboratory
1961 University Ave.
Palo Alto, Calif.

Goldak Co.
1544 W. Glenoaks Blvd.
Glendale 1, Calif.

Hoffman Radio Corp.
3761 South Hill St.
Los Angeles 7, Calif.

Magna Electronics Co.
9810 Anza Ave.
Inglewood, Calif.

Micro Specialties Co.
1834 University Ave.
Berkeley 3, Calif.

Nuclear-Chicago
229 West Erie St.
Chicago 10, Ill.

Nuclear Measurements Corp.
2460 N. Arlington Ave.
Indianapolis 18, Ind.

Nuclear Research Corp.
2563 Grays Ferry Ave.
Philadelphia 46, Pa.

Nucleonic Co. of America
196 DeGraw St.
Brooklyn 31, N. Y.

Philmore Mfg. Co.
113 University Place
New York, N. Y.

Precise Development Corp.
Oceanside, N. Y.

ALLIED has the great KIT VALUES!

TOP QUALITY • EASY TO BUILD

NEW **Geiger Counter Kit**

Uranium Locator — Radioactivity Detector

Get started in uranium prospecting now with this extremely sensitive instrument —comparable to costly equipment yet easy to build at only a fraction of the price. Just turn it on, flip the high-voltage switch and listen to the clicks in the headphone when you hit a radioactive source. Uses low-cost long-life batteries. Complete with all parts, tubes, case with handle, 22½ and 1½ volt batteries, radioactive sample and headphone. More sensitive than units selling at several times this low price. Shpg. wt., 1½ lbs.
83 S 242 Geiger Counter Kit.... **$15.95**

POPULAR **ALLIED KITS**

Famous Radio Lab Kit (10 Kits In 1)
Here's the most instructive Experimenter's kit you can buy. With it, you can build a broadcast receiver, phono amplifier, phono oscillator, signal tracer, electronic timer, photo cell relay, home broadcaster, electronic switch, etc. Fascinating, instructive. Complete with all parts, tubes, microphone, 12-page manual. Shpg. wt., 10 lbs.
83 S 265. Radio Lab Kit, only **$14.25**

Knight 3-Way Portable Radio Kit
Learn radio while you build and enjoy this sensitive AC-DC-battery portable receiver. Tunes 535-1620 kc; superhet circuit; includes: built-in antenna; automatic volume control; 5" PM dynamic speaker; handsome carrying case. Easy to assemble. Complete with punched chassis, all parts, tubes and cabinet Shpg. wt., 6 lbs.
83 SX 730. Portable Radio Kit, only **$18.75**
80 J 651. Battery Kit for above. Only **$2.48**

Dependable Knight VOM Kit
Most useful of all electronic test instruments. Features: 20,000 ohms per volt; 20 versatile ranges; precision 1% multipliers; full-vision 4½" meter; front panel "zero adjust"; single switch for selection of function and range required; sturdy bakelite case, 6¾ x 5¼ x 3¾". Complete with all parts, wire, solder, test leads, batteries and instructions. Easy to build. 5 lbs.
83 F 140. Knight VOM Kit, only... **$26.50**

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HERE'S YOUR TUBE!

Genuine AMPEREX 75NB3 Geiger Counter tube just as specified in the article.
Price only $10.00

1N34 as specified 49c 1S4 as specified 89c

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Why use costly batteries? You can save money, weight, and space by powering your Popular Electronics' Geiger Counter (or any other counter) with this amazing voltage converter which weighs less than 3 oz.—small enough to fit in the palm of hand. Delivers any voltage from 0 to 7000V by simply connecting one or two dry cells to it.
Model 10MVT—Only $9.95 Net

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We have in stock all special purpose tubes (trans., audio, industrial, photo, etc.) and crystal diodes at lowest prices. Let us know what you want or send for special list.

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Victoreen 1B85—Geiger-Mueller Tube 9.50
Victoreen 5841—Geiger-Mueller Tube 8.50
Victoreen VXR 130—Regular 6.50—Special 75
Sarkes-Tarzian 1625V, 5 Ma rectifier—
Regular 12.50 . . . . . 5.95

RADIOSONDE METEOROLOGICAL TRANSMITTER
(Weather Balloon Unit)

Type T-49C. Uses RCA 3A5. Complete with tube, antenna, battery harness. Brand New! Only 1.75.

BEST DEAL IN RECEIVING TUBES!

It pays to buy only the BEST receiving tubes. We ship only the 5 top quality brands.
• Individually Boxed • Only 1st Quality
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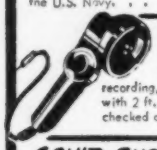
SPECIAL SURPLUS BARGAIN

MODEL GF-11 AND RU-16
RADIO TRANSMITTER AND RECEIVER SETS

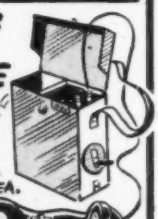
A tremendous Gov't Surplus Bargain. ALL NEW in original box. Consists of a type CW-52063A Transmitter — 2000 to 9050 KC, a CW-4051A Receiver — 195 to 13575 KC range plus all transmitter and receiver coils and boxes, a Dynamotor-Filter unit, Antenna Relay, Transmitter Control Box, Receiver Switch Box, Receiver Remote Tuning Control, Test Meter, Antenna Loop Control, plus all tubes and spares. Complete and ready to operate on 12 Volt current. Has 71 page manual and all wiring diagrams. Made by Western Electric for the U.S. Navy. **99.50**



T17 HAND MIKE

USAF type. Highly sensitive. Has thumb control button on handle. Can be used for recording, public address, etc. Comes with 2 ft. rubber cord and plug. Used but checked out and serviceable. **3.95**

GOV'T SURPLUS E.E.8 SIGNAL CORPS FIELD TELEPHONE



A private phone or intercom system. Easy to operate. Use any place that portable, 2-way communication is desired. Gives clear reception up to 15 miles. Operates on two standard batteries. Several phones may be used on the same line. Set contains a ringing generator, leather carrying case and phone. Each set is reconditioned & checked-out. **14.95 EA.**

Complete circuit — Set of 2 **29.50**

Pay by Money Order or Check. P.O.'s accepted from D&B firms. 50% deposit with C.O.D.'s. Prices F.O.B. Los Angeles.

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Precision Radiation Instruments
2235 South La Brea Ave.
Los Angeles 16, Calif.

Sierra Scientific Co.
5415 York
Los Angeles 42, Calif.

Stowers & Son
804 Grand Ave.
Kansas City, Mo.

Swift Optical Co.
P.O. Box 29
Jamaica 31, N. Y.

Technical Associates
140 West Providencia Ave.
Burbank, Calif.

Tracerlab Inc.
130 High St.
Boston 10, Mass.

U.S. Geiger Co.
195 Sackett St.
Brooklyn 31, N. Y.

Universal Atomics
19 East 48th St.
New York, N. Y.

Victoreen Instrument Co.
5806 Hough Ave.
Cleveland 3, Ohio

J. Young & Company
800 Stockton Ave.
San Francisco, Calif.

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After Class

(*Continued from page* 91)

that of Fig. (A) is needed; while it looks like an ammeter because of the heavy shunting bar, most of these movements are calibrated in volts to make it easier for the mechanic to interpret the readings. The shunt practically short-circuits the cell being measured, yet the voltage must hold its own if the battery is to perform under heavy load. To connect this instrument across a "B" battery is to commit no uncertain mayhem on the fragile cells of which the latter is built!

An instrument having a relatively high series resistance is used to check "B" battery output voltages. Since this source of e.m.f. has to provide upwards of 45 volts, as a rule, under very light loads (less than 50 ma.), the instrument which measures its voltage must have sufficiently high series resistance to keep the current drain low. (Fig. B). On the other hand, a high-resistance voltmeter connected across the terminals of a storage battery would indicate "good" even when the battery is so dead that it cannot even blow the car's horn! The answer is, of course, that this meter does not place enough of a load on the battery, so the reading is spurious. –30–

Scheme and Variations

(*Continued from page* 85)

Ninths? . . . Licorice-Stick Leap . . . The Syncopated Harp . . . Clef Hanging By Seven Frantic Fiddlers . . ."

"Go, man, *go!*" she screamed ecstatically, pounding out a double-beat with clenched fists.

"*. . . The Dixieland Theremin . . . Pastoral For Cool Cello And Tenor Fife . . . Toccata And Up-Beat: Tin Horn O'Toole And His Sheet Metal Six . . .*"

"Oh, you're so *with-it*, Dad!" she moaned. "Now spin all this real-gone stuff!"

I spun it. While the wild patterns of dissonance and butchered harmony jarred the glassware and rattled the pictures on the walls—hi-fi was earning itself another fan. I just sat there, silently praying it wouldn't scar my eustachian canal.

"Boy! This is the greatest!"

"Uh . . . yes."

"Doesn't it just send you!"

"It will," I admitted, "in time."

And a few nightmarish measures later, it sent me right out of this world . . . or out to the restful solitude of the backyard, anyway, where I offered up silent apologies to Messrs. Bach, Beethoven, Mozart, et al.

After that, I had no difficulty in spreading an extensive hi-fi system all over the place. The wife was even excited when I began planning several brick baffles and insisted upon mixing the mortar for me. Her enthusiasm for hi-fi was superseded only by her fetish for playing a twenty-four hour charivari of Bop, Modern Jazz and Experimental Music.

Well, that was all weeks ago. While I enjoy the hi-fi setup, I'm becoming restless again and my interest is turning to other, more complicated projects. Like my very own ham station with my very own call-letters, for instance. A dream of long-standing . . . being able to lounge in the comfort of my home and exchange chit-chat with amateurs all over the world. In preparation for that glorious day when I've finally gotten the license neatly framed over the finished transmitter, I've been secretly dabbling around with various oscillators—some of which occasionally give out with shrill and raucous sounds from my workshack.

Awhile back, the wife raced out of the house and was headed for the workshack just as I calmly stepped out—locking the door behind me. The patio hi-fi unit was making the welkin ring with *Persian Marketplace: Nifty McSqueal And His Nebraska Nudniks.* I assumed an air of nonchalance . . . whistling contrapuntally between my front teeth.

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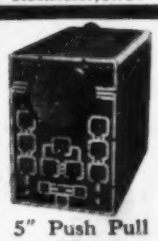

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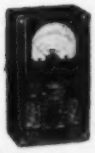

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"Was that *you*—that voice I just heard?" demanded the wife. "It sounded exactly like a broadcast coming out of this workshack! What's been going on out here, Buster?"

I broke beat and lifted an eyebrow at her.

"You're hearing things again," I cooed sympathetically. "Why don't you start playing something of a more soothing nature on the Hi-Fi?"

I've got her off balance again, I'm happy to say. –30–

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Hi-Fi Distortion

(*Continued from page* 72)

An extreme form of transient distortion which makes music sound somewhat peculiar, and is also noticeable with speech, occurs when program material is transmitted over very long land or telephone lines. Land lines normally produce losses of high frequencies, which become considerable over distances of many miles. To make up for such losses, special electronic networks are incorporated at intervals along the line which restore these high frequencies. However, although the restoration of the high frequencies results in an over-all frequency response that is flat over the range of audio frequencies, phase distortion occurs to such a considerable degree that the higher frequencies arrive a noticeable length of time later than the lower frequencies.

This results in transient distortion of a particularly obvious form, because a composite sound becomes separated in transit along the line. For instance, the sound of a clap or similar noise will arrive in two distinct parts: the low frequency part will arrive first and the higher frequency component will arrive later, thus producing a very peculiar effect quite unlike an original hand clap. Similarly, with speech, a final *"ess"* (as in the word *"has"*) will be separated as it travels along the line so that at the receiving end it will sound like a *"zee"* followed by an *"ess."* This kind of effect on speech can be quite easily observed. After noticing it in this form, a similar effect on the music can be noted with program material that has been transmitted in the same manner.

It has been proved that our ears behave somewhat in the manner of a wave analyzer, i.e., they pick out the different frequencies present in composite sound, and from the relationship between these frequencies they recognize the pattern of sound as something familiar, and there-

by identify it. All the kinds of distortion so far described do not alter the actual component frequencies present in the composite sound—they merely alter the relative amplitude or the position of these frequencies in time, in such a way that the waveform may be unrecognizable on the oscilloscope in comparison with the original. Even so, analysis would show that the same component frequencies were present at both input and output.

The kinds of distortion that are of greatest concern to the audio specialist are those that introduce components of spurious frequencies. We did not go straight into a discussion of these forms at the outset because of a common confusion that exists between the various kinds. We have discussed the simplest kinds of distortion first to avoid this kind of confusion. —30—

Rejuvenate R/C Batteries

(*Continued from page* 60)

completely isolated from the 117-volt line.

Bend the minus terminal of the 65-milliampere selenium rectifier to fit against one switch contact and solder. Solder the wire lead of the 2000-ohm, 10-watt resistor to the other contact of the switch.

Bring the output leads through the other grommet. Again, tie a knot inside the box to prevent a pull through. Solder the red output lead to the plus side of the rectifier and the black lead to the remaining terminal of the 2000-ohm resistor.

Alligator clips are now installed at the ends of the battery leads. Before replacing the cover, test the rejuvenator with a d.c. voltmeter. Set the d.c. range to the 0-100 scale. Make sure the switch is in the off position and plug the charger into an a.c. outlet. Fasten the alligator clips to the correct meter leads, and turn the switch on. Without a battery in the circuit, the meter should read between 40 and 50 volts with the needle slightly unsteady.

Now the charger is ready to be used. Just one word of caution—this is a rejuvenator in the true sense of the word, and so will *not* recharge dead cells. The purpose here is to prolong the ordinary life of the battery, and this can best be done by charging the battery after each time it is used, for approximately the length of time that the battery has been in operation.

As each battery is charged, it should be touched occasionally for warmth. If the

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1A7GT	.53	6AR5	.48	6D6	.59	7F8	.77	25BQ6GT	.82
1B3GT	.62	6AS5	.52	6E5	.60	7N7	.52	25W4GT	.43
1H5GT	.51	6AT6	.37	6F5	.44	12AT6	.37		
1L4	.51	6AU5GT	.60	6F6	.42	12AT7	.71	25Z5	.55
1L6	.51	6AU6	.43	6H6	.50	12AU7	.58	25Z6GT	.36
1LC6	.49	6AV5GT	.60	6J5	.49	12AV6	.42	35A5	.48
1N5GT	.51	6AV6	.37	6J6	.61	12AV7	.73	35B5	.48
1R5	.51	6AX4GT	.60	6K5	.60	12AX4GT	.60	35C5	.48
1S5	.43	6AX5GT	.60	6K6GT	.39	12AX7	.61	35L6GT	.41
1T4	.51	6BA6	.56	6K7	.40	12AZ7	.61	35W4	.33
1U4	.51	6BA7	.58	6L6	.78	12B4	.72	35Y4	.42
1U5	.43	6BC5	.48	6Q7	.40	12BA6	.46	35Z3	.41
1X2	.65	6BC7	.75	6S4	.41	12BA7	.58	35Z5GT	.33
3A5	.65	6BE6	.46	6S8GT	.65	12BE6	.46	37	.59
3Q4	.53	6BF5	.48	6SA7	.45	12BH7	.61	43	.55
3QSGT	.61	6BF6	.48	6SK7	.45	12BY7	.65	45	.55
3S4	.48	6BG6G	1.18	6SJ7	.45	12H6	.50	50A5	.49
3V4	.48	6BH6	.51	6SN7GT	.60	12J5	.40	50B5	.48
5R4	.95	6BJ6	.51	6SQ7	.40	12K7	.40	50L6GT	.50
5U4G	.43	6BK5	.75	6T8	.71	12Q7	.48	50X6	.53
5V4	.49	6BK7	.78	6U8	.78	12SA7	.45	75	.44
5Y3	.30	6BL7GT	.78	6V3	.80	12SJ7	.48	77	.55
5Y4G	.37	6BN6	.90	6V6GT	.48	12SK7	.45	80	.40
6A8	.40	6BQ6GT	.83	6W4GT	.43	12SL7	.60	84	.48
6AB4	.43	6BQ7	.85	6W6GT	.53	12SN7GT	.56	117GT	1.20
6AC7	.65	6BY5G	.60	6X4	.37	12SQ7	.38	117L7GT	1.20
6AQ5	.52	6BZ7	.95	6X5GT	.38	14A7	.43	117N7GT	1.20
6AH4GT	.65	6C4	.41	6X8	.80	14B6	.36	117P7GT	1.20
6AF4	1.02	6C5	.46	6Y6G	.61	14Q7	.52	117Z3	.33
6AK5	.96	6CB6	.51	7A8	.46	19BG6G	1.48	117Z6GT	.65
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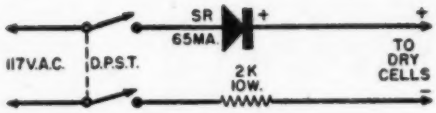
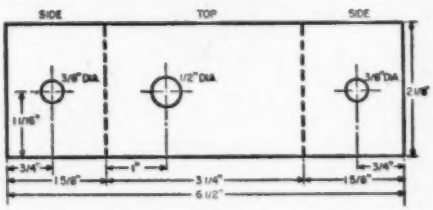


1—Bud CU2101 "Minibox"
1—6' a.c. line cord with plug
1—18" length of #20 red flexible hookup wire
1—18" length of #20 black flexible hookup wire
2—Alligator clips (one red, and one black)
1—65 milliampere Federal selenium rectifier
1—2000 ohm, 10 watt wirewound resistor
1—D.p.s.t. toggle switch
1—Toggle "on-off" switch plate
2—3/8" mounting hole grommets

Schematic diagram of the rejuvenator and parts list; note the unit's simplicity. Be careful of electric shock. The minus side of this rejuvenator is "above" ground and must not be handled or touched by the operator. A severe shock can result.

battery is a great deal warmer than body temperature, the rejuvenator should be turned off for a short period. Charging should be resumed if the battery voltage is still below normal for the battery.

When using a voltmeter during charging periods to check on the battery voltages, it should always read higher than that normal for the battery under charge. In the case of "A" batteries, the reading will only be a little bit higher; while with "B" batteries, it may go as high as 10 volts over the rated voltage. After charging, the battery will probably read somewhat higher than its rated voltage, but this will not do any harm.



Dimensional diagram of the Bud "Minibox" showing the holes for the a.c. line, battery leads, and the "on-off" toggle switch.

Many builders hook up new batteries to their rejuvenators for a few minutes to "wake them up" from their shelf life.

An especially good feature of the charger is its automatic charging voltage and rate. Because of this feature, batteries in series or parallel may be charged in an installation without removal. Simply double the time for two batteries which are connected. The only exceptions are 67½-volt batteries, which must be charged separately.

Because the charger is designed as a rejuvenator, do not attempt to charge wet cells. It will not furnish a high enough current to be effective.

Get the most out of your R/C batteries. Keep them fresh! -30-

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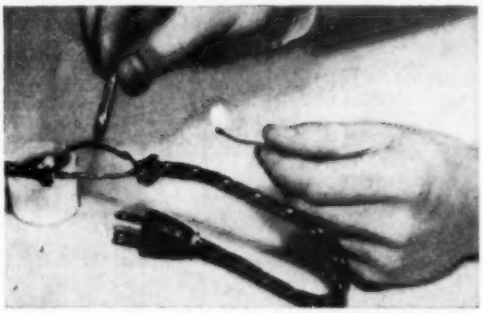

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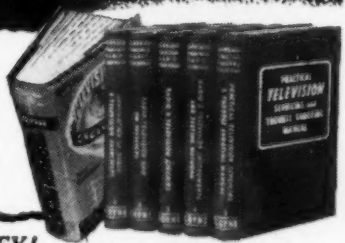

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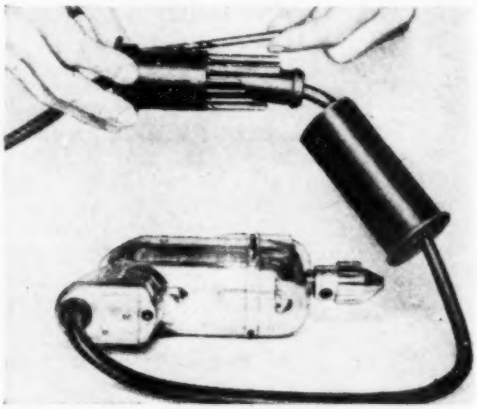
even if the holder is dropped when open, because bits are held tightly in flexible yet indestructible rubber pockets. "Bitzgo" holds 13 popular size bits, of 1/16" through

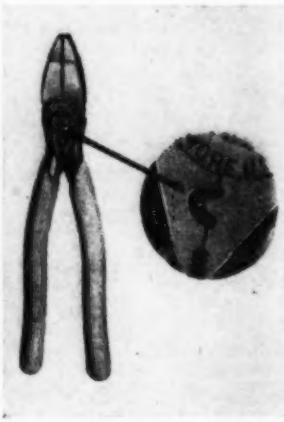


¼" by 64ths. It slips on or off the drill cord in seconds without tools, and can be moved to any position on the average size cord.

The "Bitzgo" is available in hardware stores at $1.98, or prepaid from the manufacturer, *Donart Co.*, 425 East Plymouth Circle, Minneapolis 16, Minn.

PLIERS WITH CRIMPING DIE

Allowing the technician to crimp with the same tool he uses for twisting, cutting, etc., the new *Ideal* 8½" pliers incorporate a crimping die at the point of maximum leverage. Strong mechanical joints between wires can thus be made. The "New England" nose of the pliers can get into hard-to-reach places. Handles of the tool are covered with a tough plastic to provide a comfortable and powerful grip. For further information, write to the manufacturer, *Ideal Industries, Inc.*, Sycamore, Ill.



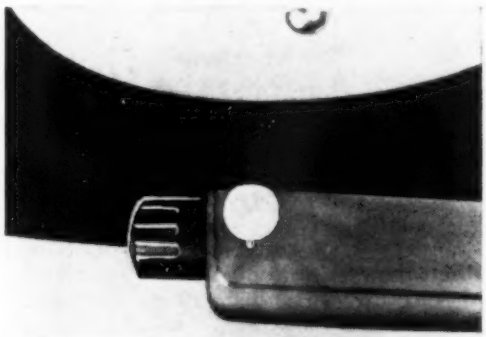
FLUORESCENT PIN-UP LAMP

Designed for convenient installation, a new fluorescent utility and pin-up lamp may be hung or screwed on the wall. Finished in triple-plated chrome, it measures 16½" long. It is furnished with a 14-watt bulb, switch, and 6' cord. For more information, write to the *Masterlite Co.*, Dept.

R. 2, 2758 Kensington Ave., Philadelphia 34, Pa.

RADIOACTIVE RECORD CLEANER

Called "Atomic Jewel, SE-9," a new radioactive device for making records dust-



resistant clips on the tone arm of any record player. It is manufactured by *Robins Industries Corp.,* 41-08 Bell Boulevard, Bayside 61, N. Y.

Styled in the shape of a tiny ball of pearlescent plastic, "Atomic Jewel" is only 9 mm. in diameter and weighs less than 1/50th of an ounce. It contains a small amount of radioactive material compounded with pure gold and silver.

The rubbing of phono needles on the surface of records in normal use creates static electric charges which attract and bind dust to the surface and grooves. "Atomic Jewel" automatically makes records dust-resistant by ionizing air at the record surface, neutralizing the electric charges.

COLORED EXTENSION CORD

A bright-red, heavy-duty rubber extension cord, said to be clearly visible against all backgrounds, is being offered by the *Royal Electric Company, Inc.,* Pawtucket, R. I. Made in 5 different lengths, it features a heavy-duty molded-on cap and connector with built-in strain reliefs. The object of the red color is to prevent the user of power tools from accidentally cutting into or tripping over the cord.

ADJUSTABLE WIREWOUND RESISTORS

Known as the "Smoothie," a new adjustable wirewound resistor features a slider band which can be loosened and tightened

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16LP4	19.38	24AP4	42.50

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1A7GT	.43	3Q5GT	.57	6B8	.69	6Q7	.40	7F7	.59	25BQ6GT	.78
1C5GT	.41	3S4	.47	6BA6	.47	6S4	.40	7F8	.70	25L6GT	.47
1D5GP	.43	3V4	.47	6BA7	.58	6SA7	.45	7Q7	.75	25W4GT	.43
1E7GT	.41	4BQ7	.89	6BC5	.47	6SC7	.48	7H7	.50	25Z5	.37
1G6GT	.41	4BZ7	.95	6BC7	.80	6SG7	.41	7J7	.75	25Z6	.37
1H4G	.43	5AW4	.75	6BE6	.45	6SH7	.43	7K7	.75	27	.25
1H5GT	.47	5J6	.63	6BF5	.40	6SJ7	.43	7L7	.75	35A5	.46
1J6GT	.47	5T4	.69	6BF6	.50	6SK7	.45	7N7	.50	35B5	.50
1L4	.45	5U4G	.43	6BQ6G	1.15	6SL7GT	.55	12AT6	.37	35C5	.50
1L6	.55	5U8	.74	6BH6	.50	6SN7GT	.55	12AT7	.66	35L6GT	.47
1LA4	.57	5V4G	.59	6BJ6	.47	6SQ7	.39	12AZ7	.63	35W4	.34
1LA6	.47	5Y3	.31	6BK5	.68	6SR7	.42	12AU6	.41	35Y4	.34
1LB4	.57	5Y4G	.36	6BK7	.76	6SS7	.41	12AU7	.53	35Z3	.39
1LC5	.49	5Z3	.41	6BL7GT	.75	6T4	.95	12AV6	.35	35Z5GT	.34
1LC6	.47	6A7	.57	6BN6	.58	6T8	.68	12AV7	.67	37	.29
1LD5	.57	6A8	.45	6BQ6GT	.78	6U8	.75	12AX4GT	.65	50A5	.46
1LE3	.57	6AB4	.43	6BQ7	.78	6V6GT	.46	12AX7	.58	50B5	.50
1LG5	.57	6AC7	.67	6BZ7	.88	6W4GT	.39	12B4	.68	50C5	.50
1LH4	.64	6AF4	.79	6C4	.37	6W6GT	.53	12BA6	.46	50L6GT	.43
1LN5	.47	6AG5	.50	6C5	.35	6X4	.34	12BD6	.48	75	.42
1N5GT	.50	6AG7	.69	6CB6	.49	6X5	.34	12BE6	.46	76	.42
1R5	.50	6AH6	.69	6CD6G	1.15	6X8	.73	12BH7	.60	77	.38
1S5	.42	6AJ5	.70	6D6	.48	6Y6G	.55	12BY7	.65	78	.38
1T4	.50	6AK5	.54	6E5	.44	7A4	.45	12BZ7	.61	80	.34
1U4	.47	6AL5	.39	6F5	.37	7A5	.53	12CU6	.95	84/6Z4	.44
1U5	.42	6AQ5	.46	6F6	.38	7A6	.45	12SA7	.45	117L7GT	
1V2	.65	6AR5	.46	6G6	.40	7A7	.43	12SJ7	.45		1.09
1X2	.61	6AS5	.48	6H6	.38	7A8	.45	12SK7	.45	117M7GT	
2A3	.55	6AS6	1.70	6J4	1.79	7B5	.39	12SN7GT	.56		1.09
2A5	.57	6AS7G	2.19	6J5	.39	7B6	.42	12SQ7	.37	117P7GT	
2A7	.58	6ATB	.39	6J6	.47	7B7	.41	12SR7	.45		1.09
3A4	.51	6AU4GT	.85	6J7	.43	7B8	.45	12V6GT	.45	117Z3	.35
3A5	.50	6AU5GT	.59	6J8G	.85	7C4	.39	12X4	.37	117Z6GT	.63
3AL5	.45	6AU6	.42	6K6GT	.37	7C5	.42	14A7	.42		
3AU6	.46	6AV5GT	.65	6K7	.39	7C6	.43	14B6	.38		
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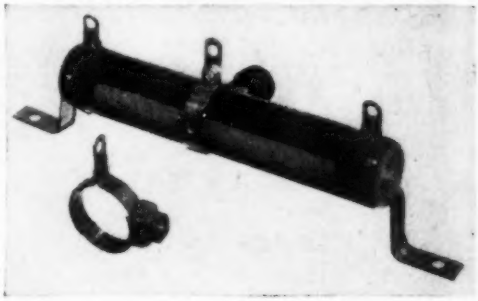


IMPROVED ELECTRICAL TAPE

Pressure-sensitive vinyl electrical tape has been developed by the *Bishop Manufacturing Corporation*, 142 Factory St., Cedar Grove, N. J., for general-purpose applications where complete electrical and mechanical protection is required. It features an improved method of bonding the adhesive to the vinyl that prevents transfer, eliminating objectionable tackiness on the backing and giving greater adhesive strength. This makes it an ideal tape for use on hard-to-get-at installations such as fixture openings, junction boxes and conduits.

RETRIEVING AND HOLDING TOOL

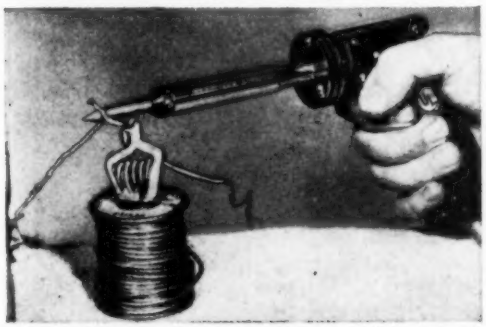
The "PROTO Grab-All" is a retrieving and holding tool offered by the *Plomb Tool Co.*, Los Angeles, Calif. When the cap at the top of the device is pressed, a cable pushes four grippers out of the bottom. These expand outward to grab objects of different sizes. A spring pulls the cable back into the casing until the grippers have a firm hold on the object. The casing is flexible and will reach around obstructions. This tool is useful for retrieving small items—metallic and nonmetallic. For further information, write to the manufacturer. —30—

TIPS and TECHNIQUES

VISE FOR FINE WIRE

When a holder for fine wire is needed, as in soldering, try forcing or wedging a universal test clip inside the opening of a solder spool as illustrated.

The weight of the wire solder on a fairly full spool will keep this temporary vise in



an upright position and permit the use of both hands for the job.

PLASTIC CONTAINERS

The out-of-doors experimenter can put plastic kitchenware to multiple uses. The photo shows a plastic container used to house the coil of a mobile antenna. Plastic containers make watertight receptacles for R/C model transmitters, antenna tuning units, and any equipment used in the field. These containers, available in all sizes, are obtainable at the local dime stores.

DRILL MAKES TWISTED WIRES

Very often it is more convenient or it looks better to use twisted pairs of wire for wiring electronic or electrical gear. Just as frequently twisted-pair wire is not available. You can make such wire quickly and with precise neatness

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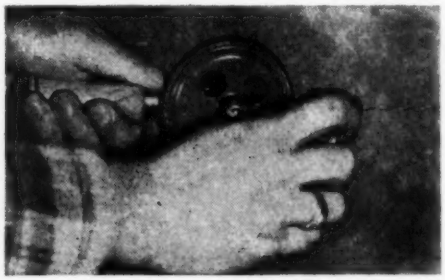
with a hand drill. Just select two lengths of single wire and fasten one end of each wire to anything handy. Then chuck the loose ends in the hand drill and turn the crank. Keep the wire taut and twist till



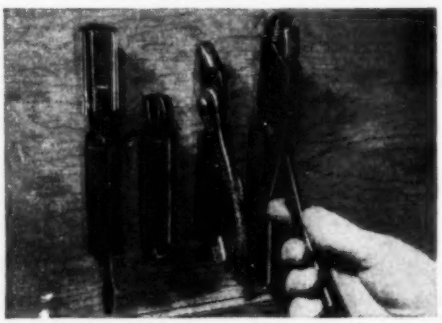
the proper appearance is achieved. Lengths of wire from a foot to several hundred feet can be made into good-looking twisted pairs this way.

SUBSTITUTE FOR LOCK WASHERS

Fingernail polish brushed over screws and nuts so that it flows down into the threads is a good substitute for lock washers. Either clear or colored polish may be employed—both hold well, but the colored polish lets you see whether you've done a good job. Before disassembling the equipment, either for repairs or to make circuit modifications, the use of polish remover will soften the hardened polish.

ECONOMICAL TOOL HOLDERS

Short lengths of old garden hose, split on one side and nailed to the wall above the workbench, make efficient tool holders. They will spread to adjust to the size of



the tools, which are released merely by pulling them away from the wall.

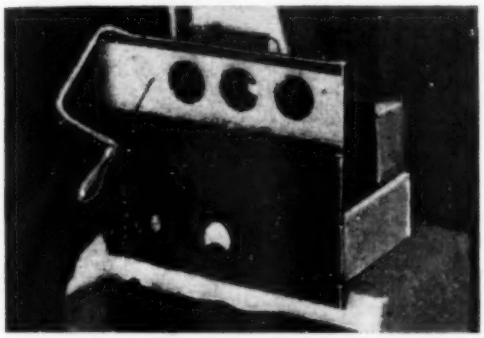
CUTTING METER HOLES SIMPLY

The coping saw in the photo is actually cutting a meter hole in a ⅛"-thick steel panel. A home workshop generally does not have a ½" chuck to handle a circle saw on the portable drill. Nor do most hobbyists have a drill press to operate a fly cutter. Drilling several holes around the periphery

of a circle to be cut out and then trying to knock the circle out with a cold chisel is crude and unnecessary.

The secret is in a little coping saw blade for metal which comes in two grades—fine and extra-fine. A jeweler's blade, or a ¼"-thick metal saw blade, will not do. There is only one blade that will fit the coping saw for metal. Called the "Trojan coping" or "scroll" saw blade for metal, #5 fine and #6 extra-fine, it is 1/16" wide, 6½" long and has 20 and 32 teeth respectively, with lock looped ends.

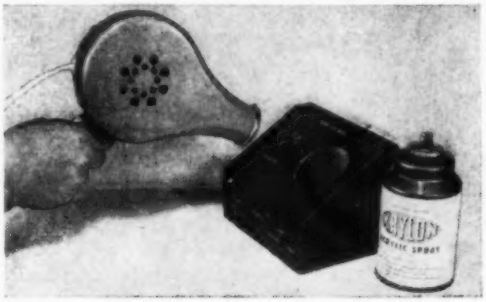
Just mark off the meter holes with masking tape. Drill a ¼" starting hole and



insert the saw blade. Then fasten in the coping saw and start sawing; you will be amazed at the ease with which meter holes can be cut.

DRYING PLASTIC QUICKLY

A hair drier is handy for reducing the



drying time of enamels, paints, and plastic finishes. Most driers come equipped with a removable stand, which may be used in drying paints and enamels. For plastic finishes, the drier may be held in the hand; the warm air stream will dry a thin plastic coat in just a few minutes. The drier may be used on individual coats as well as on the finished job. Decals, for labeling panels, may also be dried by this method.

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1B3GT	.68	5T4	.70	6C5	.36	7A8	.45	25L6GT	.48
1C5GT	.43	5U4G	.44	6CB6	.51	7B5	.41	25Y5	.45
1D5GP	.45	5V4	.60	6CD6G	1.18	7B7	.43	25Z5	.38
1E7GT	.43	5X4G	.44	6E5	.46	7B8	.47	25Z6GT	.38
1F4	.43	5Y3GT	.32	6F5GT	.39	7C4	.40	27	.23
1Q6GT	.43	5Y4G	.37	6F6	.40	7C5	.44	32L7GT	.60
1H4G	.43	5Z3	.42	6G6G	.42	7C6	.45	35A5	.48
1H5GT	.49	5Z4	.54	6H6GT	.40	7E5	.35	35B5	.52
1J6GT	.49	6A7	.59	6J4	2.00	7F8	.70	35C5	.51
1L4	.43	6A8	.59	6J5GT	.40	7Y4	.35	35L6GT	.48
1L6	.59	6AB4	.44	6J6	.49	12A6	.40	35W4	.35
1LA4	.59	6AF4	.80	6J7	.45	12AT6	.42	35Y4	.35
1LA6	.49	6AG5	.51	6J8G	.90	12AT7	.68	35Z3	.41
1LB4	.59	6AH6	.70	6K6GT	.39	12AU6	.43	50L6GT	.45
1LC6	.49	6AJ5	.70	6K8	.67	12AU7	.55	45Z5GT	.40
1LD5	.59	6AK5	.55	6L7	.44	12AV6	.37	50A5	.48
1LE3	.59	6AL5	.40	6N7	.61	12AX7	.60	50B5	.52
1LG5	.59	6AL7GT	.70	6Q7	.45	12AY7	.90	50C5	.51
1LH4	.66	6AQ5	.48	6R7	.49	12BA6	.48	50L6GT	.45
1LN5	.49	6AS5	.50	6S4	.41	12B4	.70	70L7GT	.60
1N5GT	.51	6AS6	1.75	6S7G	.47	12BE6	.50	75	.44
1P5GT	.50	6AS7G	2.25	6SA7GT	.48	12BH7	.61	80	.35
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1R5	.57	6AU5GT	.60	6SG7	.43	12J5GT	.40	117L7GT	
1S4	.53	6AU6	.43	6SH7	.45	12K8	.49		1.10
1S5	.52	6AV5GT	.75	6SJ7GT	.45	12SA7	.48	117N7GT	
1T4	.58	6AV6	.40	6SK7	.48	12SH7	.47		1.10
1T5GT	.58	6AX5GT	.59	6SL7GT	.57	12SJ7GT	.45	117P7GT	
1U4	.49	6B4G	.54	6SN7GT	.57	12SK7	.48		1.10
1U5	.80	6B8	.70	6SQ7GT	.43	12SL7GT	.59	117Z3	.37
1V	.43	6BA6	.49	6SR7GT	.43	12SN7GT	.57	117Z6GT	.65
1X2A	.63	6BC5	.49	6SS7	.43	12SQ7GT	.40	12Z3	.25
2A5	.59	6BE6	.50	6T7G	.63	14A5	.59	2050	1.25
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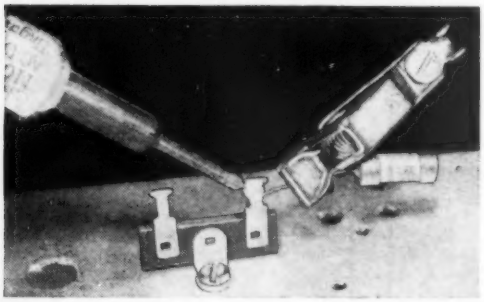
able to use a "heat sink" between the point being soldered and the body of the part. The "sink" absorbs heat and prevents dam-



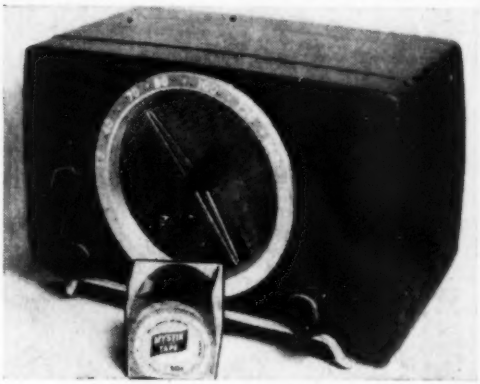
age to an expensive component. One technique is to hold the lead wire with a pair of pliers, but this requires "three hands"—one to hold the solder, one to hold the soldering iron, and one to hold the pliers. A good substitute method is to fasten a heavy metal clip to the lead wire in place of the pliers. A thick copper clip is best. It makes an excellent heat sink and is not only easy to use but quite inexpensive.

PLASTIC CABINET REPAIR

Shown in the photograph is a repaired black plastic cabinet which was badly cracked across the top, across the right-hand side, and at two places on the front. The cabinet seemed ready to fall apart, but the chassis was still in good shape.

To repair this cabinet, "Duco" cement was applied between the cracks. The cabinet was held together with strong cord tied around it. This kept the cracks closed until the cement dried. Then the cord was removed and 1½"-wide black "Mystik" tape was applied over the top and two sides. "Mystik" tape is a washable, plastic-coated, cloth band, sticky on one side.

The repaired cabinet is nearly as strong as new, and it doesn't look bad at all with



the tape over the top and sides. Tape can also be applied over the cracks on the inside of the cabinet to provide additional

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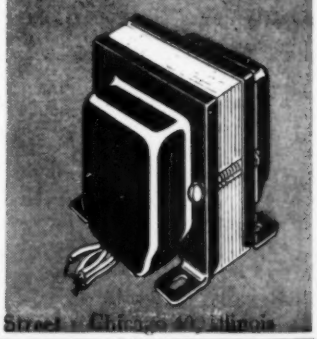

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Tape Recorders

(*Continued from page* 86)

mission and you live outside the source, the sound reaches you through lines which are restricted to a frequency response of no better than 5000-6000 cycles. The exception to this rule is TV sound, which quite often is 15,000 cycles coast-to-coast on "live" shows. Recording "off TV" is as simple as recording FM, but the input connections are not readily available and call for the help of a serviceman.

I had intended going on with these articles on tape recording techniques, especially as applied to "live" pickups, but I have taken on quite a number of new activities lately and—unhappily—I will not be able to devote my time to this column any longer. I can assure you, however, that many articles on this subject and related hi-fi subjects will be published in forthcoming issues, especially written for you by qualified experts. I may write special articles now and then, as my time permits, but otherwise—this is the finale. Yours for better sound.

Bert Whyte

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Disc Review

(*Continued from page* 87)

cording. On *Columbia* 3M14881, it is terribly outdated in sound, being a 78-rpm transfer in fact . . . but Rodzinski's way with the work is undeniably attractive and should be listened to, if only for comparison with the newer versions. The

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Urania and *Vanguard* recordings have their attractions too, but their value is largely negated by the uneven quality and frequent distortion of the sound.

Most familiar and popular of the Shostakovich symphonies in his *Fifth*. A tremendously powerful work, this is chock full of the sonic excitement so dear to the audiophile. Of the existing five recordings, once again it is Rodzinski's old 78-rpm transfer which is the performance of choice. The other four recordings are hi-fi in sound in varying degrees. The best of the lot is the Golschmann/St. Louis Symphony version on *Capitol* P8268. Except for somewhat cramped acoustics, this has excellent sounding strings, weighty brass and percussion of notable impact and clarity. Performance-wise, Golschmann does an excellent job, and this would be my choice as the "best buy" among the five recordings. Mitropoulos gives an overly fast, rather "nervous" sort of reading to the work which wouldn't sound quite so bad if his recording engineers had given him a little more clarity in the woodwinds and brass and especially percussion. The whole sonic texture is best described as "thick" and overly "bassy." The Horenstein version on *Vox* is a pretty fair performance with the third movement better here than in any of the other recordings. However, Horenstein suffers as well in the less than inspired engineering. Fairly clean strings and good brass are marred by thin and characterless percussion. The *Urania* effort is the least satisfactory due to much generalized distortion and limited dynamics. Borsamsky gives a creditable performance, but this good work is not enough to offset the poor sound.

The Shostakovich *Sixth* has more than its share of critics and detractors, and while many of their charges may have some validity, few will deny the suitability of the work as a high-fidelity vehicle. The first movement and the third and the fabulous presto-finale just cry out for a modern wide-range hi-fi recording. I say this because there is but one recording of the work in the LP catalog, and this too is a 78-rpm transfer. With all the record companies searching out the most esoteric and obscure repertoire to record, why this "natural" has been overlooked is a mystery. Fritz Reiner and the Pittsburgh Symphony Orchestra are the artists on the 3ML4249 *Columbia* disc; and although the recording easily betrays its 78-rpm origin by dry acoustics and cramped frequency and dynamic response, it is not the worst-sounding recording by any means. If you can, listen to this work. I can't honestly recommend it as hi-fi, but you will find it quite exciting and it does not take much

imagination to realize what a sensation this would be with modern sound.

The *Seventh* or *"Leningrad" Symphony* is the longest and the most controversial of the Shostakovich symphonies. Written as a "tribute" to the defenders of Leningrad during World War II, it enjoyed quite a vogue here during this country's "honeymoon" with Russia. It even had the honor of radio performances under the baton of the redoubtable Toscanini and the NBC Symphony Orchestra. The work has been categorized by many critics as a "pretentious boresome thing." There is not much doubt that it is overly long, but again I must insist that it is a good vehicle for hi-fi sound. There is a steadily insistent snare drum that persists for nearly the whole of the work, and there are many other parts of the scoring which would be productive of some terrific sounds. There are two recordings of the work in the catalog, and as you have probably guessed from the foregoing, I do not consider these recordings worthy enough to be called hi-fi. The Steinberg/Buffalo Symphony effort on the *Allegro* label is a 78-rpm transfer and is the poorest-sounding of the two, but it is by far the superior performance. Even as far back as the time that this recording was made, Steinberg was showing that he was a talent to be reckoned with, and his work these days with the Pittsburgh Symphony Orchestra is rated among the best conducting in the country. The Celibidache recording on *Urania* is a far more recent effort than the Steinberg, but in spite of this fact the sound leaves much to be desired. As with many of this company's recordings, this one has spotty, uneven sound. It can be quite brilliant and modern-sounding in some sections and quite miserable in other sections. This work obviously needs a new recording, but if I *had* to make a choice, I'd take the Steinberg.

Recordings of the Shostakovich *Ninth Symphony* are somewhat analogous to the *Seventh* reviewed above: another 78-rpm transfer, the Kurtz version on *Columbia* 3M14137, and a more modern Pfluger/Berlin Symphony version on *Urania* 7128. As far as performance is concerned, neither of these readings can hold a candle to the old 78-rpm version by the late Serge Koussevitsky and the Boston Symphony Orchestra. As far as I know, this has not been transferred to LP. Both the Kurtz and the Pfluger readings are competent and workmanlike, but neither is overly inspired. This type of repertoire was Koussevitsky's meat, and he made the most of it in this charming, spritely work. As a 78-rpm transfer, the Kurtz sounds remarkably good . . . but the Pfluger must be

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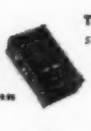

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reckoned as a pretty fair hi-fi recording. Outside of the annoyance of some wiry strings, the rest of the choirs are quite clean with especially notable woodwinds. The choice here: Pfluger's for sound, Koussevitsky for performance. It's up to you to decide which quality weighs most heavily with you.

The Shostakovich *Tenth* is the composer's most recent work and was given its American premiere under the baton of Dimitri Mitropoulos and the New York Philharmonic Symphony Orchestra in 1954. As far as most critics are concerned, the work is the most successful of the Shostakovich symphonies. I am inclined to agree with them, as certainly it bespeaks of musical maturity and has a most powerful and evocative score. There was quite a competitive rush to get recordings of this score on the market, the result being that—although a new work—there are already three recordings in the LP catalog. Mitropoulos and the New York Philharmonic have recorded it on *Columbia* 4ML4959; Mravinsky and the Leningrad Symphony do their work on *Concert Hall* 1313; and the composer himself conducts the National Philharmonic on *Colosseum* 173. In spite of what must be considered an "authentic" reading by the composer, I find I like the Mitropoulos version better. In Mitropoulos' competent hands, the work seems to have more cohesion and balance . . . more "life" and less tendency to bombast. Possibly my views on the Shostakovich and the Mravinsky readings are a little colored by the vast differences in sound. The *Columbia* disc is one of the best recordings this company has made, with wondrously sonorous contra-bassi (of which there are a great deal in the scoring), fine, clean violin and viola sound, some bright and splendid brass, and percussion of notable impact. The other two recordings have been processed from Russian masters and vary from some sections which can charitably be called fair hi-fi to other sections which are best described as impossible. The *Tenth* in the hands of Mitropoulos is an exciting score, and I predict an ever-increasing audience for the work.

We'll take a breather from the "complete works" type of review next month and go back to skipping around in the LP catalog.

Jazz Section

Columbia has turned out a 12" LP that I am certain will find favor with both the old and the new jazz buffs alike. I refer to a Woody Herman disc called *The Three Herds*. The "Three Herds" are those great bands that played under the inspired leadership of Woody Herman from 1945 to

1954. The personnel roster of the Three Herds is slightly fabulous . . . it reads like a veritable who's who of Jazz! Such great names as Chubby Jackson, the hard-driving bass fiddle man who likes to sing in an off-key falsetto along with the number he is beating out . . . the immortal drummin' man, Dave Tough . . . tall, scholarly Bill Harris, who looks more like a college professor than a red-hot trombone man . . . Flip Phillips, Neal Hefti, Nat Pierce . . . these and other stars were the bulwarks of these exciting bands.

Much of the music on this disc has been released on previous discs, mainly 78-rpm stuff, but this does not in any way detract from the desirability of the album. The numbers are culled from the repertoire of each of the Herds and contain such all-time favorites as *Caledonia, Non-Alcoholic, Keen and Peachy, Mulligan Tawny,* etc. Each is in its own way a unique composition, since the music combines the fantastic improvisatory ability of the individual stars, along with super-precise ensemble work and that indefinable "something" that made for a great swinging band. Soundwise, there is some great stuff for the hi-fi fan here . . . crisp, brillant brass work, the clean rap of the traps, the mellow "throatiness" of the sax choir. Some of the earlier numbers are a little restricted in frequency response and dynamics, but on the whole the album is more than acceptable hi-fi. Woody Herman has always had an intense interest in getting the best sound for his Herds, whether it was on records or on radio.

This brings to mind one of the most fabulous nights I ever spent in the world of jazz. About two years ago, I had the pleasure of making some on the spot experimental binaural recordings with Woody at the famous "Blue Note" night club in Chicago. Boy . . . what a ball! After the last set of the night was over, almost the entire band and I went to a friend's house where we ate corn beef and cabbage and played back the binaural tapes. You never saw such a sight as the wires and the interconnecting cables of 14 pairs of Permoflux binaural earphones. Well, the boys put on the phones and absolutely were "gone" on binaural. In the parlance of the trade, they really "flipped." At six in the morning, the boys were still swingin' and literally had to be tossed out so we could get some sleep! I still play those tapes back every now and then, and they always make me a little nostalgic.

I have no doubt that this album will do much to further the cause of what I call "classic jazz," and I recommend it most highly to the hi-fi fan and jazz lover alike.

—30—

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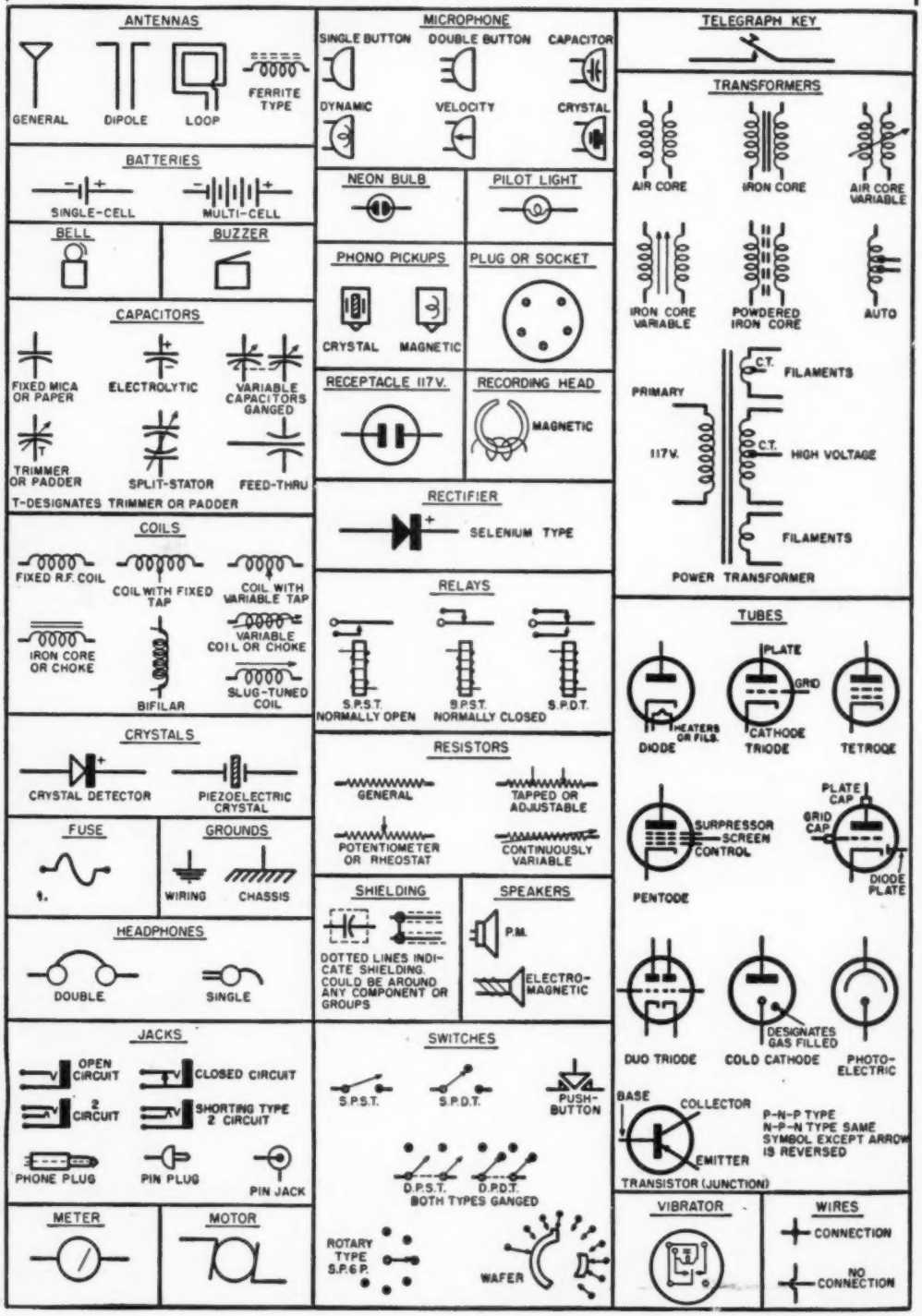

Carl & Jerry

(*Continued from page* 89)

as he said this, there was an anguished howl from below, and a frantic ball of white erupted from beneath the porch and ran crazily about the moonlit yard.

"Holy cow!" Carl gasped, "it's Bosco! What's the matter with him?"

Before Jerry could answer, Melvin's trembling voice floated up to them: "It's a mad dog!" he shrieked. Then he burst from the shadow of the porch, and with two giant steps reached the picket fence and vaulted nimbly over it. He alighted on the sidewalk running, and as his staccato footsteps died away in the distance, Jerry reached over and switched off the oscillator. Instantly Bosco's howling stopped.

"Bosco certainly fouled that up," Jerry said sadly. "Dogs can hear sounds too high-pitched for human beings, and that high frequency note must have been pretty painful to poor Bosco's ears.

The two boys went downstairs and across the yard. To their astonishment, they heard the sound of almost hysterical laughter coming from the porch, and then Norma ran down the steps, threw her arms about them, and kissed each squirming boy soundly on the cheek.

"I'll never, never forget how funny Melvin looked as he went over that fence," she finally managed to gasp. "And I want you boys to know I'll never forget what you've done for me. I guess I felt sorry for Melvin because he seemed to have so much trouble, and I foolishly thought I was in love with him; but I certainly couldn't love anyone who would run off and leave me alone with a mad dog . . . I don't know how you did it, but you're wonderful!"

As she said this, she stooped down and picked up Bosco, still pawing gingerly at his ears, and gave the dog a big hug; then she went into the house, giggling happily.

"Women!" Carl said disgustedly, as he rubbed the lipstick print off his cheek vigorously with the back of his hand.

"Check," Jerry agreed. "I suppose we may as well go to bed now, but I'm coming over the first thing in the morning to see if there are any wingless mosquito fuselages lying around under that swing."

Carl took a couple of steps and then turned around. "Hey, Jer," he said thoughtfully, "I wonder if you'd promise me something."

"Sure thing. What is it?"

"Well, if I should ever become so weak-minded as to think I want a girl friend, just let me manage my love life all by myself, will you? Please don't try to help me!"

—30—

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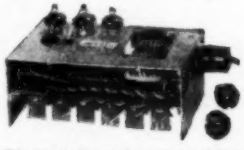

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ATOMIC RADIATION GLOSSARY

This group of working definitions of some of the terms commonly encountered in dealing with atomic radiation is reprinted by permission from the book entitled "Atomic Radiation Detection and Measurement" by Harold S. Renne, published by Howard W. Sams & Co., Inc.

alpha rays—A stream of helium nuclei. The helium nucleus has a mass number of 4 and an atomic number of 2. It consists of two protons and two neutrons.

assay—An analysis to determine the uranium content in uranium ore.

atom—The smallest particle into which an element can be subdivided and still retain its chemical properties.

atomic number—The characteristic of an element representing the net positive charge on the nucleus.

atomic radiation—Radiation resulting from nuclear reactions. The most common forms of such radiation are alpha, beta and gamma rays, and neutrons.

atomic weight—The relative weight of the atom of an element compared to some standard. Usually, the standard is oxygen, with an atomic weight of 16.

background counts—Counts caused by any agency other than the one which it is desired to detect.

beta rays—A stream of electrons.

chain reaction—A nuclear reaction in which the products of a single disintegration are sufficient to produce more than one new disintegration, thus resulting in a cumulative effect.

coincidence—Occurrence of two or more events simultaneously. It usually refers to ionizing events.

cosmic rays—Ionizing radiation entering the earth's atmosphere from outer space.

curie—A quantity of radioactive material which produces 3.700×10^{10} disintegrations per second.

dead time—The time immediately following a discharge when a Geiger tube is unable to respond to ionizing radiation.

deuterium—Heavy hydrogen, or the isotope of hydrogen having a mass number of 2.

dose—The total received quantity of ionizing radiation.

dosimeter—An instrument or device for indicating the total dose of ionizing radiation.

dynode—One of the intermediate electrodes in a photomultiplier tube.

electron—The elementary charge of negative electricity—one of the basic building blocks of matter.

electron avalanche—A condition wherein the applied voltage is large enough to accelerate ionized particles sufficiently to produce further ionization.

electron volt—The amount of energy acquired by an electron when it falls through a potential difference of one volt.

film badge—A badge containing a sensitized film which, when developed, indicates the total dose of ionizing radiation to which the badge has been subjected.

fission—Breaking up into parts. In atomic fission, the atom breaks up, producing a great deal of energy in the process.

gamma rays—Electromagnetic radiation having an extremely short wavelength and great penetrating power. Wavelength is less than that of x-rays.

Geiger counter—A complete instrument for indicating or measuring atomic radiation in which the detecting portion is a Geiger tube.

Geiger plateau—The relatively flat operating region of a Geiger tube where fairly large changes in applied voltage produce only small changes in the output.

Geiger tube—A two-electrode tube containing a small amount of gas which can be ionized by incident radiation. The normal shape is cylindrical, with a center conductor which is operated at a positive potential with respect to the conducting cylinder.

half-life—Time required for the activity of a radioactive material to be reduced by half.

halogen quenching—Quenching the discharge in a counter tube by introducing a small quantity of one of the halogens (see **quenching**).

heavy water—Water in which the hydrogen of the water molecule is in the form of the isotope deuterium.

ion—An atom or molecule which has gained or lost one or more electrons and so is charged.

ionization—The process of adding or removing one or more electrons from an atom or molecule so that it becomes charged.

isotope—Variation of an element which has the same external electron configuration in the atom and so has the same chemical properties, but which has a different mass number.

mass number—A number assigned to an atom which is equal to the sum of the protons and neutrons in the nucleus.

meson—An elusive particle which may have a unit positive or negative charge or no charge at all, and may have any number of different weights. Life of the meson is very short.

neutron—An elementary building block of matter having the same mass as a proton (hydrogen nucleus) but containing no charge.

nuclear reaction—A reaction in which the nucleus of an atom is disrupted or reorganized in some matter.

nuclear reactor—Device in which controlled nuclear reactions take place.

phosphor—A material, such as zinc sulfide, which gives off visible light when struck by nuclear radiation. The inside face of a television picture tube is coated with a phosphor.

photomultiplier tube—A tube in which the photoelectrons emitted from a cathode are multiplied by secondary emission from a series of dynodes.

positron—An atomic building block having the same mass as an electron but carrying a unit positive charge.

proton—An elementary building particle carrying a unit positive charge and having a mass about 1840 times that of an electron. The nucleus of a normal hydrogen atom is a proton.

prospecting—Searching for radioactive material such as uranium or thorium.

quenching—The process of preventing a continuous discharge in a counter tube which uses gas amplification.

radioisotope—An isotope which is radioactive.

radioactivity—Spontaneous disruption of an atomic nucleus with the resultant emission of atomic radiation.

ratemeter—An instrument for measuring the rate at which counts are received, usually in counts per minute.

resolution—Ability to separate counts which occur very close together in time.

roentgen—Unit of quantity of radiation, defined as that quantity which will produce, in 0.001293 grams of air, ions carrying 1 electrostatic unit of electricity. This amount of air is equal to 1 cc. at 0°C and atmospheric pressure.

roentgen dose meter—A meter for measuring the dose or quantity of radiation received by an object or person.

saturation—Condition in an ionization chamber when the applied voltage is sufficiently high to collect all the ions formed from the absorption of radiation, but insufficient to produce ionization by collision.

scaler—Device for indicating the total number of counts produced by a detector of some kind, such as a Geiger or scintillation counter.

scintillation—Flash of light produced in a phosphor or suitable crystal by ionizing radiation.

self-quenching—A counter tube which is quenched by means of a suitable component in the counting gas.

survey—A critical examination of the radiation near a source.

time-constant—Measure of the time required for a capacitor to charge or discharge in a circuit. It is numerically equal in seconds to the product of the resistance in megohms and capacity in microfarads.

tracer—A radioactive material used to trace the progress of a reaction or process of some kind.

tritium—An isotope of hydrogen having an atomic number of 3.

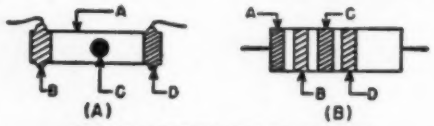
x-rays—Electromagnetic rays having a wavelength between ultraviolet and gamma rays.

-30-

ABBREVIATIONS

a.c.—alternating current
a.f.—audio frequency
a.f.c.—automatic frequency control
a.g.c.—automatic gain control
AM—amplitude modulation
amp.—ampere
ARRL—American Radio Relay League
a.v.c.—automatic volume control
BCI—interference with broadcast reception
b.f.o.—beat frequency oscillator
C—centigrade
c—curie
cc.—cubic centimeter
cps—cycles per second
c.t.—center-tapped
c.w.—continuous wave
db—decibel
dbm—decibels above one milliwatt
d.c.—direct current
d.c.c.—double cotton-covered (wire)
d.p.d.t.—double-pole, double-throw
d.p.s.t.—double-pole, single-throw
DX—distance
elec.—electrolytic
F—Fahrenheit
FCC—Federal Communications Commission
FM—frequency modulation
freq.—frequency
G-M—Geiger-Mueller tube (usually referred to as Geiger tube)
GMT—Greenwich Mean Time
hi-fi—high fidelity (of sound reproduction)
hr—hour
hy.—henry
i.f.—intermediate frequency
K—kilo (one thousand)
kc.—kilocycle
M—mega (one million)
ma.—milliampere
mc.—megacycle
meg.—megohm
mike—microphone, microfarad
mil—milliampere
m.o.p.a.—master oscillator, power amplifier
mr—milliroentgen
mr/hr—milliroentgen per hour
mu—amplification factor
μfd.—microfarad
μμfd.—micromicrofarad
mw.—milliwatt
m.w.—medium wave
PA—power amplifier
p.a.—public address
PM—phase modulation, permanent magnet (speaker)
pos.—position (of a switch)
pot.—potentiometer
pri.—primary
RC—resistance-coupled
R/C—radio control
rect.—rectifier
res.—resistor
RETMA—Radio-Electronics-Television Manufacturers Association
r.f.—radio frequency
r.m.s.—root mean square
sec.—secondary
SN—self-neutralizing (escapement)
s.p.d.t.—single-pole, double-throw
spkr.—loudspeaker
s.p.s.t.—single-pole, single-throw
s.w.—short-wave
SWL—short-wave listener
sync.—synchronization
t.—turns (of a coil)
trans.—transformer
TV—television
TVI—interference with television reception
u.h.f.—ultra high frequency
v.—volt
v.f.o.—variable frequency oscillator
v.h.f.—very high frequency
VR—voltage regulator
v.t.v.m.—vacuum-tube voltmeter
vu—volume unit
w.—watt
wpm—words per minute
xmtr.—transmitter

RESISTOR COLOR CODE



RETMA COLOR CODE CHART

COLOR	VALUE	MULTIPLIER
Black	0	1
Brown	1	10
Red	2	100
Orange	3	1000
Yellow	4	10,000
Green	5	100,000
Blue	6	1,000,000
Violet	7	10,000,000
Grey	8	100,000,000
White	9	1,000,000,000

TOLERANCE CODE

Gold—±5% Silver—±10%

No Color—±20%

The ohmic value of a resistor can be determined by means of the color code. There are two standard methods of indicating this value.

In Fig. A, the body (A) and end (B) indicate the first and second digits of the value while the dot (C) indicates the multiplier to be used. The tolerance of the unit is indicated by the end color (D). For example, if the body (A) is green, the first number is 5; if the end (B) is grey, the second number is 8. If the dot (C) is red, the multiplier is 100 or two zeros should be added. The resistor is then a 5800-ohm unit. If the end (D) has no color, the tolerance is ±20%.

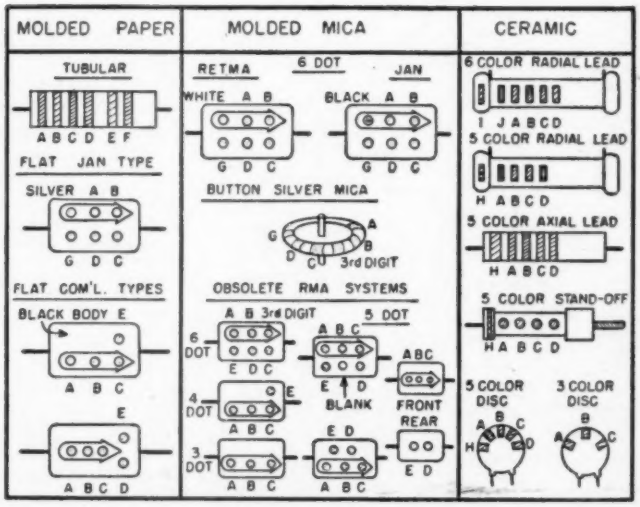
In Fig. B, the first two stripes indicate the first two digits; the third stripe the multiplier; the fourth stripe the tolerance. Thus, if stripe (A) is green, (B) is grey, (C) is red, and (D) is silver, the resistor is a 5800-ohm, ±10% unit.

CAPACITOR COLOR CODE

	MOLDED PAPER		MOLDED MICA		CERAMIC	
Color	Multiplier	Tolerance	Multiplier	Tolerance	Multiplier	Tolerance
Black	1	20%	1	20%	1	20% or 2.0μμfd.*
Brown	10		10		10	1%
Red	100		100	2%	100	2%
Orange	1000		1000	3% (RETMA)	1000	2.5% (RETMA)
Yellow	10,000	5%	10,000		10,000	
Green				5% (RETMA)		5% or 0.5μμfd.*
Blue						
Violet						
Gray					0.01	0.25μμfd.*
White		10%			0.1	10% or 1.0μμfd.*
Gold	0.1	5%	0.1	5% (JAN)		
Silver		10%	0.01	10%		
None		20%				

*Capacitance less than 10μμfd.

Capacitance is given in μμfd. Colors have same values as on resistors, except as indicated in tables. Colors (A) and (B) are for first two digits; (C) is for multiplier. (D) is for tolerance. (E) and (F) give voltage rating in hundreds of volts; (E) is used only for ratings less than 1000 volts, (E) and (F) for first two digits of ratings 1000 volts or more. Values of colors for (E) and (F) are same as in resistance values. (G) is class or characteristic of capacitor, (H), (I), and (J) give temperature coefficient. (G), (H), (I), and (J) are not listed in the tables, since this information is seldom needed by the average home builder.



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(Questions on page 91)

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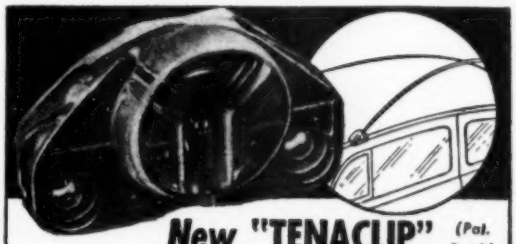

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The "Electronic Wayfinder" was developed by *Femco, Inc.*, of Irwin, Pa. —30—

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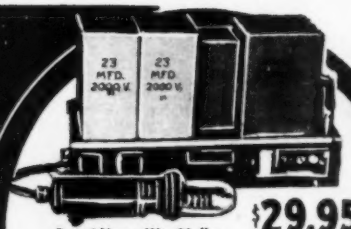

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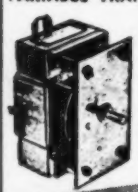

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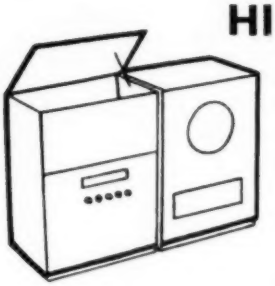

Model 80 has lift lid, removable panels. Bass reflex tuned for 12" or 15" speakers. Overall dimensions: 33½"H, 23"W, 16"D. M80 tuner section, inside: 20"H, 21¾"W, 15½"D. M8112, M8115 baffle volume: 6 cubic feet. ⅝" white pine

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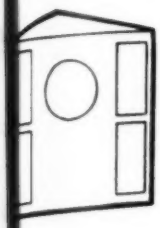

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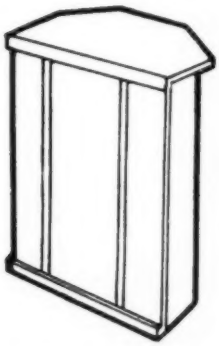
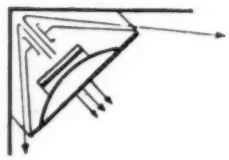


MODEL K-12—$36.00
MODEL K-15—$42.00



DIRECT RADIATION OF HIGHS
BACK RADIATION OF LOWS

REBEL enclosure development entails a cavity and slot port, to form a resonant chamber, and a horn coupled to the slot. The slot is loaded by the horn; the proportioning of slot, cavity and horn provide bass response below 100 cycles which corresponds in efficiency to the front-of-cone direct radiator response above this critical 100-cycle point. There are two ways one might consider the function of this horn. One is a bass reflex with a horn acting as a resistive load on the port. System resonances are damped by useful radiation resistance while the horn does not cost anything. It is already formed by the room corner. Again, if a full horn were added below the 100-cycle point bass response would be boomy and unnatural. But, in the Rebel enclosures, the cavity-port combination acts as an acoustic low pass filter. And its design is such that low-end response will compare with response higher in the sound scale.

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- 10 tubes, 1 rectifier and voltage regu

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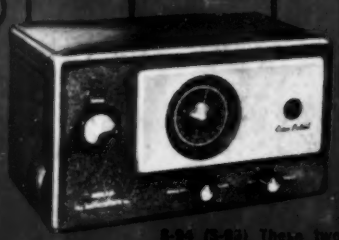

HAM

S-96 (S-63) These two new Civic Patrol receivers are over 10 times as sensitive as previous models. Increased audio power output and built-in PM speaker system. Perfect for monitoring, police, fire, telephone-mobile, forestry, Civil Defense, etc. S-96 covers 30-50 Mc and the S-95 150-175 Mc. Built-in speaker and provisions for headphones on rear. 105-125 V. 50/60 cycle AC plus rectifier.

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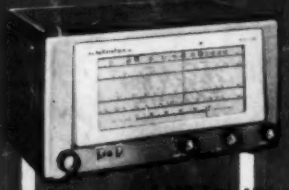

S-40B Extra value in this unit with high priced performance over Broadcast Band 540-1650 kc plus three short-wave bands from 1650 kc-32 Mc. Electrical bandspread operates over large area of dial. Headphone tip jacks on rear and powerful built-in PM speaker. Oscillator for reception of code signals. Four tubes plus rectifier. 105/125 V. 50/60 cycle AC/DC.

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